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OF THE

NATIONAL FIRE PROTECTION ASSOCIATION

"To Promote the Science and Improve the Methods of Fire Protection and Prevention."

PUBLISHED QUARTERLY AT BOSTON, MASS., BY THE
NATIONAL FIRE PROTECTION ASSOCIATION

Printed in U. S. A.

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Vol. 36 October, 1942 No. 2

QUARTERLY

OF THE

National Fire Protection Association

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Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

Perhaps typical of hundreds of fires which have been retarding the United Nations' war effort was this blaze which destroyed the Easton Iron and Metal Company plant at Easton, Pa. The fire was attributed to a spark from an acetylene torch. While the loss from this fire was reported by the fire chief at only $11,500, it is of more than usual interest because the plant was equipped to do tire retreading, and most of the loss consisted of damage to used tires suitable for retreading, new camelback used in the retreading process, and a substantial number of retreaded tires. In all about 3,000 tires were lost.

The Quarterly

Vol. 36 October, 1942 No. 2

Trucks for Auxiliary Fire Apparatus.

By John H. Alderson (Member N.F.P.A.),
Chief, Fire Department, Los Angeles, California.

J. M. Landis, Director, U. S. Office of Civilian Defense, has been able recently to announce the encouraging fact that pumpers for auxiliary fire companies are shortly to be forthcoming. These will be allotted to cities on a priority system based on OCD's estimate of which cities are likely first to be in need of them, but the important thing is that they are coming.

Last winter a delegation of chiefs of fire departments of important cities was invited to OCD headquarters in Washington to check on its plans for auxiliary pumpers. The staff of the OCD Fire Defense Section explained the plans. The pumper units to be provided appeared to be surprisingly satisfactory in view of the difficulties facing the OCD and its technical advisers. Principal difficulties were due to critical shortages of materials, notably copper and rubber, and the fact that the fire apparatus industry was already at the limit of production capacity due to work for the Army and Navy. Specifications for the pumpers had been written and rewritten as this or that new shortage made changes necessary. By endless ingenuity, most of the changes were accomplished without basic performance of the pumpers being substantially affected.

Briefly, the pumper units, including 500 g.p.m. centrifugal pumps, were planned as follows: (a) a front mounted pump on a 1½-ton truck, (b) a self-contained pump assembly—pump and motor on skids—by itself, (c) a self-contained unit mounted on a 1½-ton truck, and (d) a self-contained unit mounted on a trailer. With each unit it was proposed to furnish enough hose, ladders, pump cans and tools, to make a complete pumper.

This did not sound too bad, although no one was fooling himself that these pumpers were the equal of those to which American fire departments have been accustomed. It looked, however, as if the worst news had been saved especially for this meeting of fire department heads. Just the day before, the

Los Angeles Fire Department.

A panel body truck now in service as an auxiliary hose company. It carries a load of hose and small tools. Plans are to use it to tow a trailer pumper unit when the latter becomes available.

Office of Production Management handed down the edict that so far as the proposed pumpers were concerned, new truck chassis were out—definitely.

We were left, then, with pumps for front-mounting, the self-contained skid units, and trailer units (these latter to have wooden wheels and steel tires). It was perfectly clear, then, that if automobiles for auxiliary apparatus were to be used, they would have to be second-hand ones.

I expressed the thought at the time that suitable second-hand trucks could be found for the purpose and this has been confirmed by experience. To date we have secured for auxiliary companies in the Los Angeles Fire Department a total of 82 trucks and actually have 73 of them in service. More are available when they can be equipped.

We had sufficient old hose on hand which was still serviceable so that with this and some small tools, we were able to equip the 73 automobile units as hose wagons. We have not waited for delivery of the OCD pumping units, since no one could say with certainty how much apparatus we would get, or when we would get it. Los Angeles is tentatively allocated 143 skid pumps and 143 trailer units by OCD, but there are still a lot of factors which may make delivery dates uncertain.

Los Angeles Fire Department.

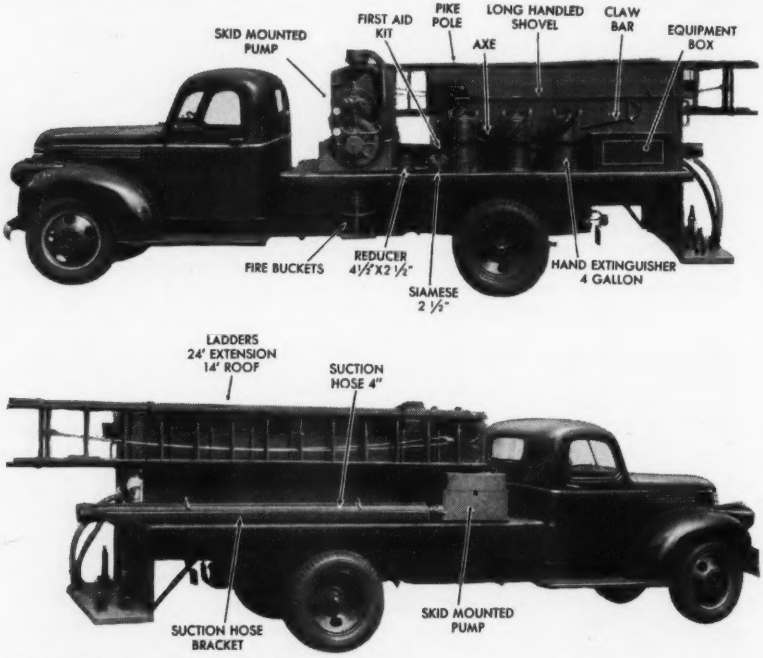
A truck purchased by auxiliary firemen and given to the city. This is at present equipped as a hose wagon, but can be used to carry a skid mounted pump or to tow a trailer pumper.

Los Angeles Fire Department.

A typical 1½-ton truck contributed by a milk company in service as a hose company. It may eventually be painted and other body changes made, as it is suitable to carry a skid mounted pump unit.

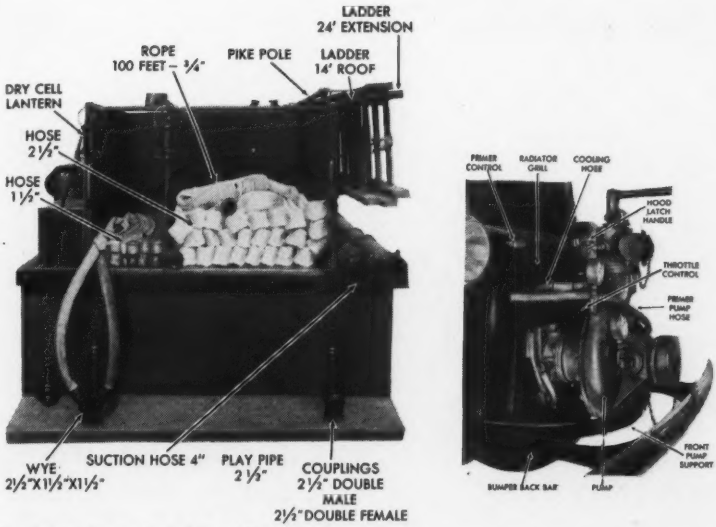
After learning last January that no new trucks were to be forthcoming, a survey in Los Angeles indicated that a considerable number of used trucks were being laid up due to the restrictions of the Office of Defense Transportation. These restrictions particularly affected firms using a large number of trucks for delivery purposes. Contacts were made with milk companies, trucking companies, package delivery firms and other similar organizations. Also contacted were numerous individuals who had formerly operated one-man, one-truck businesses, but who are now working in war plants.

Left with trucks on their hands they could not use, these owners appeared glad enough to turn them over to some good cause. As many as ten trucks



Fire Defense Section, U. S. Office of Civilian Defense.

The pump units and accessory equipment to be provided by OCD for auxiliary fire companies are beginning to be delivered. The pictures show how this equipment may be assembled on a typical 1½-ton truck. Shown above is one of the self-contained skid mounted pump units plus the standard hose body and tools. The truck shown is one with extra long wheel base. There is also space on a truck of standard wheel base for the entire assembly. In most cases, a department that wishes to install a booster tank on the truck can do so with a little ingenuity—provided they have material for the tank. When a front mounted pump is used there is adequate space for the tank. With skid mounted pumps, a truck with long wheel base may be required to provide room for the tank. The ability of the truck to carry the extra load of a filled tank is also a consideration.



Fire Defense Section, U. S. Office of Civilian Defense.

OCD equipment includes not only the pump units, but 400 feet of 2½-inch hose, and 200 feet of 1½-inch hose, with hose body, ladders, suction hose and other tools shown in accompanying views. The arrangement of equipment is the same whether the pump is front or skid mounted, so this rear view (left) is typical of both models. OCD pumps for front mounting are installed as illustrated (right). Trucks selected for these pumps must have motors with proper speed characteristics. Most late models of standard make have such motors.

have been donated by one firm without cost to the city. In many instances the owners overhauled, repainted and retired the trucks before presenting them to the fire department.

The arrangement under which the use of some of these trucks is obtained is one of mutual satisfaction to both the owner and the city. The owner would find it difficult, on his own part, to keep an idle truck in running order. The fire department in accepting the truck agrees to give it reasonable care and maintenance and return it to the owner when and if the emergency passes. This is expressed in a letter signed by the chief engineer of the department. It is pretty much of a gentleman's agreement, however, as the fire department does not undertake to return the car under all circumstances. If it is worn out or damaged the owner understands he may never see it again, but he is perfectly willing to take that chance.

As a matter of practice it has been necessary in a number of instances to definitely discourage the contribution of trucks in view of the fact that no definite promise can be made that the trucks can be equipped and put in service. It has been our experience that used trucks can be secured when the

Los Angeles Fire Department.

This picture shows what public spirited auxiliary firemen can do. The auxiliary station has good apparatus floor space, an assembly room and kitchen. This is rented and equipped by the auxiliaries at their own expense. The truck, too, bears evidence of intelligent use of makeshifts. The ladder, obviously home made, is of sturdy workmanship. Large paint cans make a practical substitute for water pump tanks which are not yet generally available.

proper approach is made and the problem is explained to truck owners. The experience of Los Angeles is duplicated by that of a number of other communities in Southern California and there is no reason to suppose we are differently situated than fire departments in other parts of the country.

The auxiliary fire companies which we have established have received splendid support from their neighborhood and community groups. In a number of instances such groups have raised funds to buy suitable trucks which have then been sold to the city for the nominal sum of one dollar. The public spirit of the auxiliary firemen themselves has been evident in securing trucks, providing minor equipment and putting them in service. The auxiliaries in many cases raised the necessary funds to put trucks in good repair, through benefit dances and by community and neighborhood donations. In one case ticket sale for a benefit dance was stimulated when an auxiliary truck was taken from door to door throughout the neighborhood. Part of the auxiliary crew drove the truck while others sold tickets. People were invited out to see the truck.

Los Angeles Fire Department.

One and one-half ton truck with hose, ladder and small tools. Note how relatively little has to be done to such a truck to make a serviceable piece of apparatus. Such a truck could be equipped with a front mounted pump or, with additional body changes, a skid mounted pumping unit, or be used to pull a trailer pumper.

The use of second-hand trucks for fire apparatus is by no means an ideal arrangement. The trucks which have been secured are of a number of makes and types. Maintenance would be much easier if the trucks could be standardized. We have protected ourselves against inferior machines by having the fire department mechanical force look over each truck offered us. Thus we can be satisfied that the condition of the truck is good enough to put in service or to overhaul for the purpose.

The department has proceeded on the assumption that all new trucks are needed by the armed forces and other imperative defense activities. We have considered it our patriotic duty to do the best possible job under the difficult circumstances with which we are faced.

An Ill Wind Blows Some Good.

By Percy Bugbee.

Americans have always been careless about fire. Year after year thousands of people are burned to death and additional thousands are seriously incapacitated by fire burns, and millions upon millions of dollars worth of property has been destroyed by fire.

Recent developments indicate a change. The American public has become aware of the destructiveness of fire and imbued with an urge to prevent fires. This change in the public consciousness about fire waste is already reflecting itself in a more satisfactory loss record.

There are a number of factors which have been operating to bring about this more satisfactory situation. The public has had a thorough and sustained object lesson in the destructiveness of fire during the three years since the outbreak of this war. Fire has become a major weapon of modern warfare; the incendiary bomb has been utilized to a far greater degree in this war than in any previous war in history. Because of the widespread use of incendiaries, the civilian defense program has to a very considerable degree concentrated upon fire control. Many of the millions of people enlisted in civilian defense have learned for the first time the elementary precautions to take in controlling fire waste, have been taught what the simple causes of fire are and have been told to clean up their attics and basements. Then again the country-wide conservation program has led additional millions to clean out their properties, thereby automatically reducing the fire hazard.

Other factors are also at work. There has been much talk about the threat of sabotage and the necessity of watchfulness for outbreaks of sabotage. Almost everyone knows that fire has always been a major weapon of the foreign agent bent on malicious destruction, and steps taken to forestall and prevent sabotage help prevent fires. The crack-down on new construction and the knowledge that a home or place of business destroyed by fire today may be extremely difficult if not impossible to replace is also a potent factor in inducing carefulness about fire hazards.

In 1941 and early in 1942 we were in a period of increased production, increased values, additional hours of work, speed-up of industrial processes and induction of many untrained workers, all factors tending to encourage an increase in fire loss. During 1941 and early 1942 we had a series of disastrous fire losses in important defense and war industries. Many of these perhaps did not catch public attention, but two did—the Fall River rubber fire late in the fall of 1941, and the *Normandie* fire in February, 1942. These two fires, more particularly the *Normandie* fire, aroused more public interest and indignation over carelessness with fire than any fires of recent years and, like the use of

incendiary bombs as a war weapon, engaged public attention and focused the spotlight of public concern on the destructiveness of fire in war time.

Protection against fire and the prevention of fire are not particularly difficult to bring about once the public is aroused to the necessity for observing certain elementary principles. Most important perhaps and most obvious is the principle of limiting concentration of values. If a large amount of material that will burn is in one place, subject to one fire, then the chances of a large loss are present. If that same amount of combustible material is split up into small piles, then if a fire occurs only a small amount of material will be destroyed. If it is necessary because of certain industrial situations to have a substantial concentration of combustible material at one point, then a concentration of fire protective equipment must be supplied to take care of the special hazard.

The number of fires that occur in the United States in any one year is in the neighborhood of 700,000. The great majority of these fires are due to very simple and easily understood causes, such as the careless disposal of cigarettes and matches, careless handling of gasoline, kerosene and other flammable liquids, failure to maintain heating and electrical appliances in proper working order, dirty chimneys, rubbish accumulations, etc. If these obvious causes of fire are looked for, understood, and eliminated periodically, then fire losses drop as a matter of course. The more people appreciate the simple rules of fire prevention, the less fires will occur.

There are a few other important principles of fire protection that apply perhaps more particularly to industrial and mercantile fires rather than home fires, although they have an application to all fires. One of these is the desirability of always promptly calling for help when a fire breaks out. You would be surprised how many big fires become big fires because the person or persons first discovering the fire attempt to handle it without calling for help. There are various well-known devices to detect and extinguish fires, such as fire alarm systems, automatic sprinklers, fire extinguishers, etc. It is important to have the right kind of fire protection equipment for the hazard involved and a small expenditure for equipment may save a total destruction of property. No industry or mercantile establishment of importance today should be without a volunteer crew of organized and trained personnel to take care of a possible fire emergency. Under present war conditions the establishment of private fire brigades has rapidly expanded to all sorts of business ventures and has proven its worth many times over.

The time has perhaps arrived when fire will no longer be looked upon as a misfortune, but as a misdemeanor. The person who permits a careless fire to occur and destroy life or property today is perpetrating a crime against society and is damaging the war effort. The ignorance of or indifference to fire hazards can no longer be held up as a valid excuse. Any person who has the slightest inclination to learn about precautions against fire can obtain all the information desired from firemen, insurance agents and others.

"Confidential."

By Robert S. Moulton.

Information of all kinds which might afford any aid or comfort to the enemy is very properly restricted during the present war period. Documents and reports of various kinds which bear upon war industry and various phases of military operations are marked "secret," "confidential," or "restricted." An informal and unofficial censorship at the source has developed, because of a general desire to coöperate in keeping vital information out of enemy hands, a lack of knowledge as to just what kinds of information might be of aid and comfort to the enemy, and a fear of possible trouble with government authorities due to inadvertent violation of somewhat vague censorship policies.

The net result of this situation as seen by the N.F.P.A. executive office is to withhold much information which would be of value in the prevention of fires and explosions in war industries, military supplies and stores of critical materials. Actual fire experience is the best possible guide to preventive measures, and over the years since the N.F.P.A. started the formulation of standards for fire prevention and fire protection in 1896, information on fire experience has been made freely available. All serious fires have been carefully investigated. The lessons learned have been published for the benefit of all concerned so that in future design and operation measures could be instituted to prevent repetition of serious losses under similar circumstances. It seems to us that the prevention of fires and explosions is of utmost importance to avoid interference with various phases of the war effort and that the general circulation of information on the fires which are now occurring is the very best method of focusing attention upon the hazards that have been responsible and pointing the way towards suitable preventive measures. To a considerable extent this orderly and logical development is still being followed by the N.F.P.A., but the Department of Fire Record is now finding it increasingly difficult to secure information on fires in defense industries and military properties.

We feel that this situation is unfortunate and should be rectified through a proper understanding on the part of all concerned. In releasing information on fires and explosions which have occurred, no one wishes to publish anything which would be of aid and comfort to the enemy. However, it seems illogical to withhold from Americans information useful to them, which would obviously be easily secured by enemy agents and which, in all probability, is already in the hands of the enemy. We feel that it would be in the national interest to adopt a policy of making freely available information about fire hazards and precautionary measures that have been found effective, and about fires and explosions which have occurred, suppressing details only where the information would clearly be of aid and comfort to the enemy and where there is a

reasonable assumption that the information is not already in enemy hands.

The N.F.P.A. office receives many requests for information about hazards and fire experience from plant fire chiefs and others in defense industries handling explosives or other hazardous materials with which the operating personnel has had no extensive experience. Similar requests come from governmental inspection agencies. To some extent we are able to provide the information, but in other cases we cannot do so because everyone in the industries concerned seems to feel pledged to complete secrecy. The chairman of one of the N.F.P.A. committees recently had occasion to visit a considerable number of plants all handling explosives in similar processes. He found no uniformity whatsoever in the safeguards employed. This is obviously due to the failure to utilize available facilities for the interchange of information, such as provided by the regular machinery of the N.F.P.A.

Photographs seem to come under a particular ban. Photographs of spectacular fires which have been due to lack of some essential safeguard or carelessness on the part of employees furnish one of the best available methods of showing the layman the importance of proper precautions. For this reason we endeavor to secure and publish photographs of the important fires and explosions which present the most significant lessons. Generally when a major fire or explosion has occurred the matter is such obvious common knowledge that suppression of photographs would seem futile. We are referring, of course, to photographs of a general nature and not those which would give any information about secret processes or equipment, etc. The case of a recent water front fire in an eastern port will illustrate the current situation. The property involved was in process of conversion for war purposes; nothing of military significance was involved. An acetylene torch was used and a spark ignited creosote wooden piling. Huge volumes of smoke from the creosoted timber spread over a large area and hundreds of thousands of people knew about the fire before anything had been published about it. The black smoke was photogenic and a half dozen newspaper photographers rushed to the scene. The smoke was so dense that no photograph could have shown any detail of what was burning and even if details had been shown it is hard to see how they could have been of any aid or comfort to the enemy, as what was involved was really only a site being cleared for future operations. Nevertheless six newspaper photographers were arrested. Their release was secured only with considerable difficulty.

One angle of the apparent desire to suppress fire news is that publicity on fires is often rather uncomfortable for the management of the property. Most major fires in these days involve someone's ignorance, carelessness, or neglect. The man whose failure resulted in a loss naturally wants no advertising and is quick to see that if he invokes the cloak of military secrecy his own part in the fire may not be noticed.

Howard Clifford, Tacoma News-Tribune.

The tideflats industrial section of Tacoma, Washington, was threatened when a fire was discovered at 4:15 A.M. on September 24 in the Fick Foundry, occupied as a machine casting and pattern plant. Two adjoining plants were somewhat damaged, but automatic sprinklers were helpful in checking the spread of the fire. Initial estimates placed the damage at approximately $30,000, but the damage to equipment may increase the final loss.

Forest Fires in Alaska.

By J. N. Hessel,
U. S. Forest Service, Washington, D. C.

When the heat's on in the timber and above the jangling of the telephone or the crackling of the flames you hear in strident, stentorian tones something like this: "I'm gonna quit this business and find me a place somewhere in the middle of a swamp"—you know you're in the presence of an experienced fire fighter and that everything is being well taken care of. The more stentorian and profane this proclamation, the more experienced the fire fighter is likely to be.

Top-notch forest fire fighters make this fervent announcement all summer and brood about it all winter. None, or at least very few of them, ever actually do anything about it. This also is typical.

Granted the opportunity of an extensive Alaskan junket with Dr. Dow V. Baxter of the University of Michigan, and his student assistant Fred Walker, last summer, I set this matter down as one for special investigation.

Via the Alaska Steamship Line's S.S. *Alaska,* we eventually arrived in Resurrection Bay and disembarked at Seward. On turning up at the Forest Service headquarters of the Kenai Division of the Chugach National Forest in the Federal Building in Seward, searching for one Emil Norgorden, in charge, I was due for a shock.

Ranger Norgorden, I was informed, was at Kenai Lake, where he had been and where he would remain for the duration of the *fire season.* It was then late July and as nearly as I could gather this meant from early June to early September, depending on the time of the spring break-up and fall rains just as in the Northern Rockies and Pacific Northwest.

Although an occasional fire is started by brush-burning homesteaders, by prospectors, or by sportsmen who travel far to enjoy the famed hunting and fishing of the Kenai country, the chief hazard—believe it or not—is a Government-owned railroad.

This railroad extends from Seward to Fairbanks and the trains which run at indeterminate intervals have at one time or another started tremendous fires from practically one end of the route to the other. One of the features of the line is a screw trestle which takes the train out of the valley and over the mountain. This is a renowned scenic thriller for the Alaskan sightseer, but to the Kenai ranger it's a pain in the neck.

The matter of screens on the locomotive smokestacks has never been satisfactorily settled. During the burning season a speeder patrol after every train making the haul over the mountain is considered essential.

This article has been reprinted from "Fire Control Notes," a publication of the Forest Service, U. S. Department of Agriculture.

U. S. Forest Service.

A raging forest fire sweeps along the Iditarod River in Alaska.

We traveled over the Alaska Railroad to Anchorage. In an office in the Anchorage Federal Building I found W. N. "Bill" McDonald and Roger R. Robinson representing the Department of Interior's Alaska Fire Control Commission. Bill, an old-time Alaskan, put in many years as a member of the Region 10 Forest Service organization, previous to taking over in Anchorage. Robinson, a graduate forester from New York State College, also previously served with the Forest Service in West Virginia, Colorado and Alaska.

"Folks in the States have no idea of the fire job there is to do up here," they told me. "Here is Alaska with an area of 546,000 square miles, about a fifth the size of the 48 states. And except for the 25 million odd acres in the Tongass and Chugach National Forests, we're responsible for protecting the whole of it. We get a total appropriation of between thirty and forty thousand dollars—sometimes not that much. You can see what we're up against."

"Yes," I replied, "but I've flown over considerable of the country and there must be a big area you don't have to worry about, and there can't be much need for spending a lot of money protecting it. As far as I can see all the good and accessible timber is down along the coast in the national forests. What do we lose if this back country does burn over?"

"Look," said Bill, "you like to hunt migratory birds, don't you? Well, this is where your migratory birds come from. They nest up here and when those nesting grounds burn over, as they do, the answer is obvious—fewer birds."

"Sure," Robinson backed him up. "You've flown over a big area and you've seen a lot of rock and muskeg country that we don't have to worry about, it's true. But there's more of it you haven't been over. You haven't been up in the interior around Fairbanks. There's some good timber up there as well as down along the southeastern coast. And timber means a lot to the isolated people mining and trapping and developing that area.

"Then take the case of the reindeer range. Reindeer are important up here for meat and hides for both the Eskimos and white population. They're suitable for export and the day may come when there will be enough of them to make an important industry, but not if we continue to let the range burn. A good stand of reindeer moss doesn't spring up overnight. It's slow growing —a good thick growth takes years. But it burns just like grass once it gets started."

"And don't forget," wound up Bill, "that fires start in the spring and burn all summer. They cover thousands of acres every year and we can't even spot them. We've got to depend on reports from prospectors or whoever happens to be in the country to know about them. Sometimes they burn for weeks before any word ever gets out to us.

"The only way we can get to the fires is by plane, and we have no planes. Then once we get to the fires they're too big to handle with the few men we can muster and hire to fight them. With our little money all we can do is hammer away at prevention.

"You go back to the States and tell them we've got a fire control problem up here that's a dinger. Tell them we've got to have more money, more equipment, specialized equipment and more manpower. Especially tell the sportsmen—they've got an immediate interest."

I heard about fires and saw evidences of past fires in Alaska, and on the way outside in the middle of September I had an opportunity to actually fight two fires where you'd least expect to find them—in the heavy rain forests along the southeastern coast.

After a day's run in the Ranger 8, one of the fleet of Forest Service boats, we were cruising in to a late anchorage in one of the countless small coves, when Fred suddenly said, "Look across there—there's a fire."

Taking a look I could make out a dim illumination. "Maybe it's just a beacon of some kind," I said. "I'll go up in the wheelhouse and take a squint through the glasses."

Up in the wheelhouse Skipper George Reynolds and Harry Sperling of the Juneau office had already spotted the light.

"It might be a gas-boat on fire close to the shore," said Harry.

"Too high," said George.

"How about a settler's cabin?" I asked.

"Nobody along this part of the coast that I know of," replied George.

U. S. Forest Service.

This old burn in the Skagway Valley, Alaska, was formerly a fine stand of hemlock and spruce, much of it three feet in diameter and one hundred feet tall.

We were nearer now and daylight was growing very dim. Flames suddenly broke out brightly and raced up almost to the top of the shoreline trees. Anchoring a safe distance off shore we donned hip boots, put the dinghy over, and with pump, hose, shovels, Pulaski tools and axes, rowed and waded to a landing. Pushing through a dense growth of shore grass, head high and reeking wet, we emerged suddenly at the edge of the fire.

Under the thick canopy of great spruce trees the fire had caught the dry matting of needles and spread over about a tenth of an acre. The shooting flame we had seen was a run of fire up through the branches. With the exception of this one catch, which had been of brief duration, the crowns at that season of the year were apparently impervious. At the base of one of the trees were what we took to be the remains of a campfire—apparently how and where the blaze started.

Setting up the pump and coupling together enough hose to reach all parts of the fire required but a few moments. Among other things loaded into the dinghy on leaving the boat was one of the steel folding chairs, out of the galley. When set up on the beach the chair served as an elevated stand for the gas tank, gravity-feeding the pump. Because of the highly corrosive effect of salt water, pumps when not in use are kept tightly capped and filled with oil.

Within less than an hour all visible sparks had been well doused with brine from the Pacific. Mopping up was left for the morning. Since the fire

had obviously been smoldering for several days before actually breaking out in the open, it had become deeply established under roots and rocks, which called for considerable digging and hacking.

Hardly had we again got underway after dispatching this fire than another was sighted. Except that it was smaller, of more recent origin, this second fire in all other respects was identical to the first. About two hours was all that was required to drown and dig it out completely. A driftwood board set up at one end of the beach near the fire had been shattered with bullets. At the opposite end of the beach we found a number of empty 30-06 cartridges, establishing this almost unquestionably as a hunter's fire.

I am not generally credited as a scientist nor do I by any manner of means represent myself to be one. That my investigative technique in this instance might have been faulty and incomplete is quite likely. But to me the dictum is clear: Fire fighting is a disease as unshakable as a bad habit.

Two fires in two days in the heart of Alaska's swamp Utopia leave nothing more to be answered. Recognizing my fate, I resign myself to fire fighting unconditionally, regardless of where I may be.

The broken line indicates the path of the police officer's body following the gasoline explosion at the Hodge Drive-It-Yourself garage shown at the extreme right. As a result of this explosion, in which five men were killed, efforts are being made to outlaw all interior gasoline pumps in Cincinnati.

Cincinnati Garage Explosion.*

Gasoline pumping facilities located inside garages have been responsible for a number of explosions and fires which have resulted in loss of life and extensive property damage. An examination of our fire records for the past ten years reveals reports of fourteen such fires. These reports are but typical cases and doubtless constitute only a fraction of the total number of such fires which occurred during the same period. While the number of reported fires and explosions is not large, the circumstances of each case do indicate the nature and severity of the danger of placing gasoline pumps inside buildings.

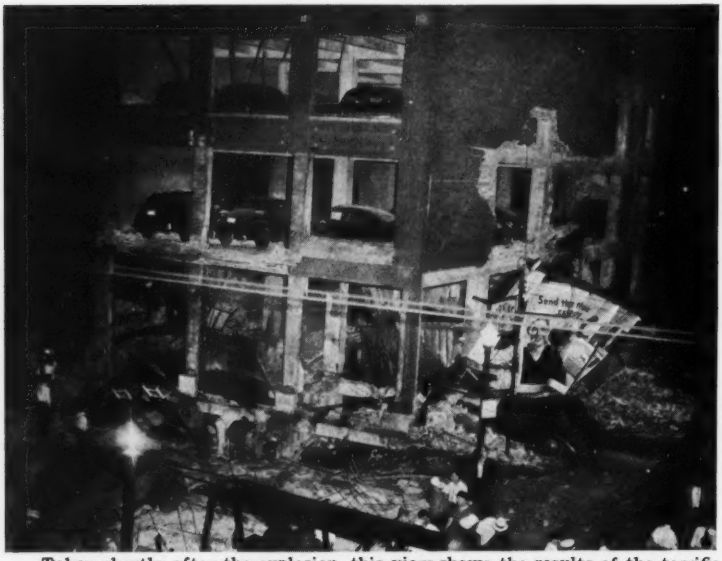
In all but one case the explosions or fires resulted from carelessness, a fact which emphasizes the folly of assuming that a situation is fire safe simply because all equipment is properly constructed and well maintained. Overfilling of automobile fuel tanks ranks as the principal factor, while striking the pump pedestal with an automobile or truck is also a leading cause of the fires of which we have reports.

The extent of damage from these fires varies widely, ranging from cases where, due to a happy combination of circumstances, the only loss was a few gallons of gasoline, to such a fire as that which destroyed the Silver Fleet Motor Express Terminal at Chicago with a loss estimated at $250,000. (See January, 1942, QUARTERLY, page 201.)

The most recent and one of the most destructive of these tragedies occurred at Cincinnati on July 15, 1942. In this case a violent explosion, resulting from the discharge of gasoline from a broken automobile filling pump pedestal, thoroughly wrecked the lower half of a three-story and basement reinforced concrete garage building occupied by the Hodge Drive-It-Yourself Company. Four men were instantly killed, another was fatally injured, and the blast caused minor damage, including hundreds of broken windows in buildings within a radius of several blocks. Damage has been estimated to approximate $150,000.

Those present prior to the explosion, which occurred at 11:26 P.M., were two employees, two customers and a police sergeant who had just arrived in a cruising car. An anonymous telephone call had been received by a fire alarm operator stating that a truck had struck a pump, but that there was no fire, and the caller then hung up. The fire alarm operator called the police operator, who is located in the same building, and asked him to send a man to investigate and report. Had the circumstances been accurately reported by the unknown caller, three fire companies would have responded instead of the police officer and the loss of life would probably have been much greater.

*This report has been prepared from information furnished by the Ohio Inspection Bureau (member N.F.P.A.), Cincinnati Fire Marshal L. G. Schraffenberger (member N.F.P.A.), and other sources.



Taken shortly after the explosion, this view shows the results of the terrific force which severely damaged the reinforced concrete and brick garage.

The only information that can be obtained as to the circumstances leading up to the explosion is the account given by one of the customers who lived for two days after the blast. He stated that when he drove in, gasoline was flowing over the floor. One of the employees explained that he had accidentally backed a truck into the pump pedestal, which was located inside the front entrance of the garage. The impact evidently broke the 1½-in. pipe connecting the pedestal with the pump in the basement and jammed the switch mechanism so that the pump was operating. Not only was the gasoline flowing on to the floor, but a considerable quantity had also run down into the basement by way of an opening through the floor alongside the pipe.

Just as the customer suggested that something be done about it, the police sergeant arrived, and an employee started for the basement to shut off the electrically operated pump. According to the survivor, the employee could not yet have reached the switch when the explosion occurred. The two employees and one of the customers were instantly killed. The police officer was blown over the roof of a 3½-story building across the street, his body falling into an alley about 250 feet from the garage. The other customer was blown across the street and died two days later from burns and injuries.

The entire first floor and about one-third of the second floor of the garage were completely demolished and the remainder of the second floor was badly cracked and distorted. All first story wall panels, about half of those on the second story, and some of those on the third story were blown out. Several

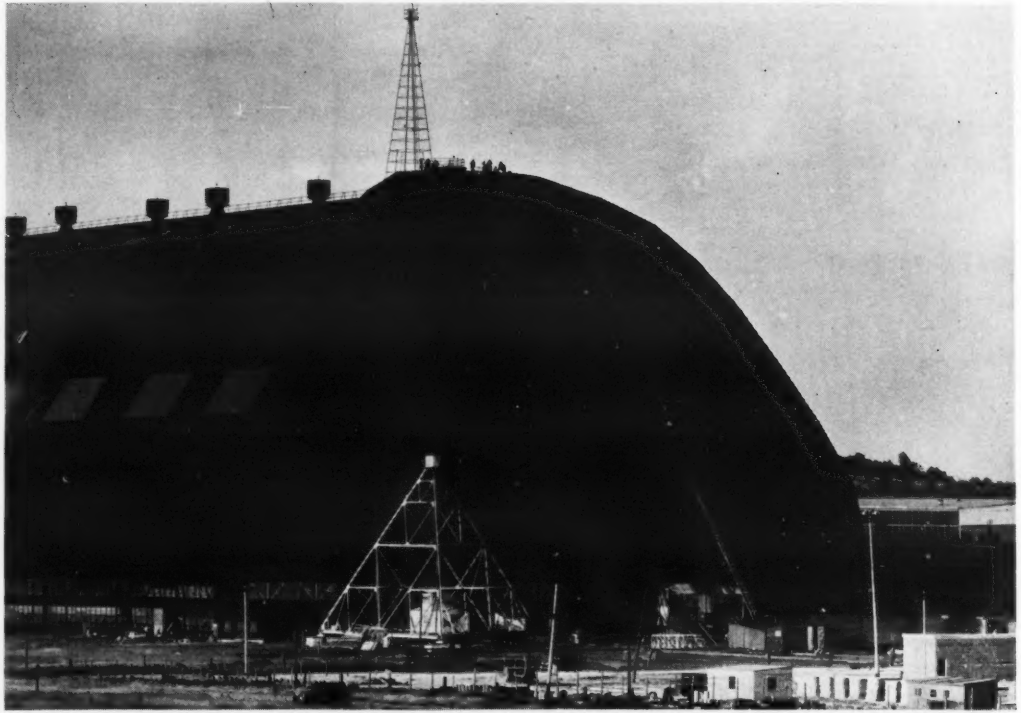
Resembling a London street scene after a bombing raid, the ruins of this Cincinnati garage graphically demonstrate the explosive force of gasoline vapors. This is a view of the rear of the building.

columns were broken horizontally at the lower floor level as if by a shearing stress and many of the first and second floor girders were not only broken but cracked loose from the columns. The basement extended under the sidewalk and it is believed that the police sergeant was standing on the sidewalk when the explosion blew him upward.

How much time elapsed between the damage to the pump pedestal and the explosion is not known, but it is apparent from the severity of the blast that a great amount of vaporization must have taken place. Neither is it known what actually caused the spark that ignited the explosive vapors. There was a manually operated gas heater in the basement which was customarily shut off each night, and subsequent examination has confirmed that this heater was not burning at the time of the explosion. There was a light switch on the wall of the cellar stairway which the employee may have operated to light the basement. It is possible that one of the victims may have been smoking but did not immediately come in contact with the explosive vapors.

There was no appreciable fire following the explosion. A few minor blazes were quickly extinguished by a fire company who saw and heard the explosion and made a quick run from the station two blocks away.

Because of the explosion, efforts are being made in Cincinnati to enact an ordinance prohibiting the future installation of gasoline pumps inside buildings and requiring the removal of all existing pumps which are so installed.



The provision of a dry standpipe on the suggestion of fire protection engineers at this huge hangar of the Goodyear Aircraft Corporation plant in Akron, Ohio, permitted firemen to control a fire started by an acetylene torch which swept 325 feet of rubber weatherstripping sealing the doors of the structure. *Akron Beacon-Journal.*

The Navy's Fire Fighters.

Fire fighting on the high seas is of the greatest importance today among the activities of the United States Navy; and fire fighting equipment for the forces afloat gets top priority preference. Groups of officers and sailors are attending the newly set up Navy fire fighter's schools to learn more about the principles and technique of fighting fires in Navy vessels. And all this because now more than ever before in naval combat, fire is the greatest menace; every improvement in torpedo and shell adds to their capacity to cause damage and destruction by flame as well as by disruptive force. Reports from the fleets everywhere emphasize the immediate necessity for increasing the means and improving the skill required to cope with this tremendously increased hazard, one that is (and in no mere oratorical phrase) a positive threat to the nation's safety.

When a warship is struck by a shell or a bomb or a torpedo, there is a high probability that a fire will result—a fire that will cause damage in inverse ratio to the speed and efficiency with which the ship's fire fighters go to work. These officers and sailors often have the fate of their ship and shipmates in their hands, and indeed, the fate of a fleet. The Navy is determined, therefore, that its fire fighters shall have the finest equipment and the best training for fighting fires at sea, and especially under combat conditions.

To meet the mounting demand for trained fire fighters, the Navy has organized five fire fighter's schools; two are on the Atlantic coast—at Norfolk and Boston, and two are on the Pacific coast—at Mare Island and Bremerton, and one is at Pearl Harbor. The schools are conveniently located for the attendance of officers and sailors detailed for a short course while Navy vessels are in port. As soon as a Navy vessel comes to the vicinity of one of these schools, arrangements are made for the fire fighters aboard to attend the school for periods varying from one to ten days.

A majority of the students at the fire fighter's schools take the one-day course; a smaller number take a three-day course; and a still smaller number remain for the ten-day course. With the present facilities and the present rate of enrollment continuing, the five schools will have taught fire fighting techniques to approximately fifteen thousand officers and sailors by the end of the first year. Many of these students impart instruction to other officers and sailors who have not had an opportunity to attend the fire fighter's schools.

This article has been supplied by the Secretary of the Navy, Office of Public Relations. All the photographs were taken at the Boston School.

year Aircraft Corporation plant in Akron, Ohio, permitted firemen to control a fire started by an acetylene torch which swept 325 feet of rubber weatherstripping sealing the doors of the structure. *Akron Beacon-Journal.*

Students in the Navy's Fire Fighter's School are kindling a demonstration fire in the simulated engine room of a destroyer.

Students at the Navy's Fire Fighter's School are extinguishing a fire in the simulated engine room of a destroyer. They are using water to extinguish the fire shown in the preceding picture.

At the schools the officers and sailors find organizations for instruction in fire fighting functioning under the direction of Naval officers who have been members of fire departments in various parts of the country. These officers have had years of experience in fire fighting in cities and harbors, and they have made a study of Naval problems. They direct a course of study that has been prepared for the five schools, and that is administered from the Damage Control Section of the Bureau of Ships of the Navy Department. In addition to providing instruction, the Navy's fire fighter's schools serve on occasion as a proving ground for new equipment. After practical experiments in the schools and regular official tests, the Navy accepts and sends out to the fleets the latest improved equipment for meeting the war-time fire hazard at sea. As rapidly as posssible older means are discarded and the newer are substituted, and in consequence of this constant improvement and of the rapid expansion of the Nation's sea forces, there is an ever-increasing demand for men trained in the new fire fighting techniques.

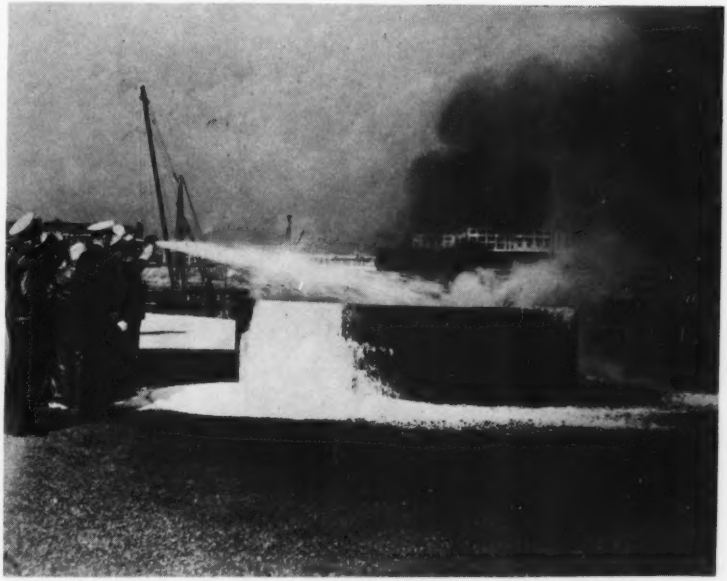
The demonstrating installation used at the schools is immediately familiar to the officer and sailor students, inasmuch as it consists chiefly of a land-

based "mock-up" of three compartments of a Naval vessel. Constructed of steel, concrete and fire brick, these compartments are models of the forecastle, boiler room and engine room of a typical destroyer. Everything except the machinery is reproduced, and in actual size. In addition to the simulated destroyer compartments, the schools have other enclosures for practice in extinguishing oil fires, and one for extinguishing gasoline fires, the latter with the familiar "Christmas tree" device which sprays the interior of its corrugated iron enclosure with gasoline under pressure. A shallow water tank is used for practice, with shallow diving equipment. The tank also serves as a source of water supply when a portable pump (the handybilly) is demonstrated.

The Navy's Fire Fighter's School curriculum must of necessity be readily adaptable to the time any particular group of students can devote to a course, and this time varies a great deal. Whenever possible, the students are given a ten-day course; but if an officer or an enlisted man cannot be spared from his ship for more than one day, or if the ship is not to be in port longer than one day, a one-day course is provided. Obviously, little can be done by way of teaching fire fighting in a single day, except to acquaint the students with the equipment and give them a more or less general instruction in its use. But at least, preparation is made for further study aboard ship, which the student pursues with the help of fellow officers and crew members, and the *Navy's Fire Fighter's Manual.*

The fire fighter school students who can remain for the ten-day course receive a thorough training in the use of the Navy's fire fighting equipment and the Navy's equipment for protecting the fire fighter. They learn about the fire extinguishing agents used aboard Navy vessels—about carbon dioxide, chemical foam and mechanical foam, water, steam, fog, and fog foam. They learn also what they need to know about hose and nozzles, hose evolutions, water pressures and the capacity of hose and pumps. Further, they learn about fire main installations aboard Navy vessels and the various adjustments that the hazards of battle may necessitate. Upon completion of their course, the fire fighter school students are familiar with the tools they must use, and likewise they are aware of the problems that may soon confront them under actual battle conditions.

In the conduct of the Navy's fire schools, theory is subordinated to actual practice, as far as it is possible to do so. Although the students are shown motion pictures of fires and fire fighting in progress and attend lectures, they are given many opportunities to see real fires and to participate in the work of extinguishing them. They man the hose and handle the fog and foam nozzles. They play carbon dioxide on electrical switchboard fires, and they turn steam into compartments or they don asbestos suits and breathing apparatus and climb down hatches to apply water on fires in waste materials, or they extinguish oil fires with fog.



Students are shown how to extinguish fires in flammable liquids by various methods. This picture shows the demonstration of the use of mechanical foam.

Classification of fires as A-fires, B-fires and C-fires does not remain long a matter of theory to the students in a Navy fire fighter's school. They see fires of each class kindled and they participate in or direct the work of extinguishment. These fires are set in the simulated destroyer compartments in order to give the fires all possible resemblance to actual fires aboard Navy vessels. In these compartments all machinery spaces are indicated and passageways, vents and exits are reproduced; the student finds conditions exactly as they would be in an actual destroyer with a fire in one or more of its vital compartments.

For the demonstration of Class A fires waste material of various sorts, such as old mattresses, is piled in one end of the "forecastle" compartment. The pile is saturated with oil and ignited. The students detailed to extinguish this fire know from their instruction that water is the indicated agent, since the burning waste material will respond best to a wetting, which brings the temperature below the ignition point. The students do not need to recall any instruction, however, to realize that for this fire they must carry a hose line into the compartment in order to direct it upon the fire for the wetting effect that is indicated. They have to protect themselves against the smoke and poisonous gases, and against the possibility of coming momentarily into con-

Using a water spray nozzle to extinguish an oil fire simulating fires that might occur at sea. This picture shows the use of the low velocity fog nozzle on an applicator.

tact with the flames. They put on asbestos suits and breathing apparatus, and climb down through the hatch, confident that they could remain below for nearly an hour, if necessary, and that their asbestos suits will afford protection against flames and for a few minutes at a time against heat that would not otherwise be tolerable.

In the next demonstration the bilges of the "boiler room" compartment are flooded with fuel oil, and the oil is ignited. The resulting fire is a Class B fire, one that is not ordinarily to be attacked with water. The students need only to look down through the hatch to realize that for this fire they are not to go down into the compartment: the entire deck is ablaze. The students remain at the hatch. One student applies fog through the hatch with an applicator in order to put a cover over the fire that will permit another student to stand at the hatch and apply a smothering blanket of mechanical foam. The foam quickly builds up a sufficient depth to extinguish the burning oil; and the fire fighter students have learned how to extinguish one of the most difficult fires, and one that they are most likely to encounter at sea.

With the Class A and Class B fires extinguished, another problem remains to engage the attention of the students: how to extinguish a fire

in electrical equipment, a fire that is called a Class C fire. In the "engine room" compartment gasoline in a trough just below an electrical switchboard is ignited. For this fire the students know that they must use a non-conductor of electricity. They extinguish the fire with carbon dioxide from portable fifteen-pound containers. Low velocity fog would be their second choice for this fire, but they know that while the finely diffused fog is a poor conductor of electricity, it has a wetting effect, and therefore it would put electrical equipment out of use temporarily. Water, the fire fighter students have learned, must not be used on electrical equipment fires unless it can be applied in some way that will remove the danger of electrical shock.

In addition to the extinguishment of various kinds of fires, an important part of the training of the fire fighter school students is that in which they learn what to do when the fire main in any section of a ship fails to function. The students learn how to resort to jumper lines that reach around ruptured sections of the main, and to set up and operate a portable pump, the handybilly pump. They use the pump to take water, supposedly, from over the side, or on the fire main to boost pressure that has been weakened by unusually heavy demand or rupture or in some other way. The tank used to supply water for the handybilly is also the experimental tank for shallow diving instructions. The fire school students learn how to don a diving suit and go below the surface, presumably for rescue and repair work.

In general, the procedure at the Navy's five fire schools consists of motion picture showings of fires and fire fighting methods at sea, lectures, and practical work with the various Navy devices and extinguishing agents. At the end of each ten-day course examinations are held; the students are given grades which are placed on record. They are then sent back to their ships to participate in the work of fire fighting, when occasion arises, and to do so with a better understanding of the problems involved and the means for solving them.

Glens Perrins, Deseret News.

Fire started on the top floor of this department store in Salt Lake City at 6 A.M. on September 28. The estimated loss was $100,000. The undermanned fire department was barely able to control this one fire with the aid of auxiliary firemen. Because of the lack of proper gas mask equipment ten firemen were overcome.

$100,000. The undermanned fire department was barely able to control this one fire with the aid of [illegible] lack of proper gas mask equipment ten firemen were overcome.

Waterloo Daily Courier.

The newspaper account of this fire in a tire repair shop in Waterloo, Iowa, was headed "BUSINESS BLOCK SWEPT BY MYSTERY FLAMES." There was, however, no mystery about this fire. The fire walls stopped short of the roof and provided an unrestricted passage for the flames from section to section. The loss in this instance was reported at $26,495.

Firemen's Training 1942.

More than 130,000 firemen are annually receiving training under organized firemen's training programs throughout the United States and Canada. These figures indicate the continued development of interest in the subject since it was last reported on in the QUARTERLY. (State Programs for Firemen's Training—A 1939 Survey, by N.F.P.A. Chief Engineer Horatio Bond, QUARTERLY, January, 1939, Vol. 23, No. 3, page 223.) Firemen's training is of special immediate importance, as at the time this issue of the QUARTERLY goes to press the first of a series of important conferences is being held which is expected to give great impetus to the development of more and better firemen's training work.

This latest development is brought about by the increased demands which are made upon fire departments in war time. The United States Office of Civilian Defense is offering substantial aid to states and cities which now have firemen's training programs through arranging to provide teacher-training for a corps of approximately 150 key fire department instructors. The first of four conferences for these key instructors is being held this month at Pennsylvania State College, State College, Pa. The idea is that each of the 150 key instructors will become qualified teacher trainers and then under the direction of state agencies for vocational education will in turn train other firemen as fire department instructors. A goal of approximately 15,000 new instructors by the middle of February, 1943, does not seem unreasonable.

The work of training firemen has, as previously reported, engaged the attention of a great many N.F.P.A. members for a long period of years. Clarence Goldsmith as Chairman of a Fire Service Extension Committee of the United States Chamber of Commerce was successful in giving impetus to training programs in many states through the organization of annual short courses. The International Association of Fire Chiefs secured the interest of the United States Department of Education in firemen's training work in 1931. As a result, through training funds made available by the George-Deen act of 1936, most of the states are able to carry on a modest program principally of providing administration and supervision of state firemen's training programs.

N.F.P.A. Vice-President Richard E. Vernor has made a unique contribution to the advancement of fire department training through the annual sponsorship by his organization, the Fire Prevention Department of the Western Actuarial Bureau, of a Fire Department Inspectors' Conference. While Mr. Vernor has assumed primary responsibility for setting up the program of this conference, it has enjoyed joint sponsorship with the Memphis, Tenn., Fire Department, Irby Klinck, Chief. The tenth annual meeting of this conference was held at Memphis last January. Fire department instructors were present. 364

in number, from 27 states. The Memphis conference has become the principal annual gathering of both the fire department instructors and as a forum for the exchange of ideas between those in charge of state and municipal training programs. Teacher training conferences for the instruction of fire department officers and drillmasters in teaching techniques have become one of the most important developments in the firemen's training program. No matter how well an officer knows his subject he must be taught how to put his ideas across to a class and how to organize his material. A total of 1977 firemen in 15 states and two provinces attended instructor training courses during the past year. It is upon such men that the actual work of training both the regular and auxiliary firemen falls.

In 1941 the N.F.P.A. organized its Committee on Firemen's Training, bringing together a group of the men who, by their work up to that time, had demonstrated their leadership in firemen's training programs in the various states and cities. The committee went to work immediately, preparing an outline of recommended training for auxiliary firemen, which was in demand because of the large numbers of auxiliary firemen being recruited throughout the country.

The committee was fortunate in being able to secure as Chairman Mr. W. Fred Heisler. As leader in the training program of the State of Oklahoma he has made significant contributions to the advancement of firemen's training. With the coöperation of fire department instructors in Oklahoma, he has developed text material which has come into wide use not only in Oklahoma, but in other states, notably as official training texts in Alabama, Arkansas, Florida, Kentucky, Indiana, Iowa, Michigan, New Mexico, North Dakota and Pennsylvania.

When the U. S. Office of Civilian Defense decided to sponsor a program which would assist existing agencies to increase the effectiveness of their training program, the N.F.P.A. committee was asked to prepare an outline of the recommended fire defense training. The committee was brought together in June at the U. S. Office of Civilian Defense in Washington and has produced a report on recommended fire defense training which is shortly to be made available to N.F.P.A. members.

The proposed program of the Office of Civilian Defense is not to be thought of as one which can be separated from existing firemen's training programs. Its sole purpose is to produce an additional back-log of instructor personnel which will aid the state and local programs in carrying out their present objectives. It will build up these local programs and will not in any way supersede them.

Also, the training here under discussion is training as it applies to regular firemen. Training auxiliary firemen is a separate, though related, problem, which can only be assisted by an increase in training of regulars.

There are six states in the Union which do not carry on some form of State-wide firemen's training program for 1942. These are Idaho, Mississippi, South Carolina, Rhode Island, Utah, and Wyoming.

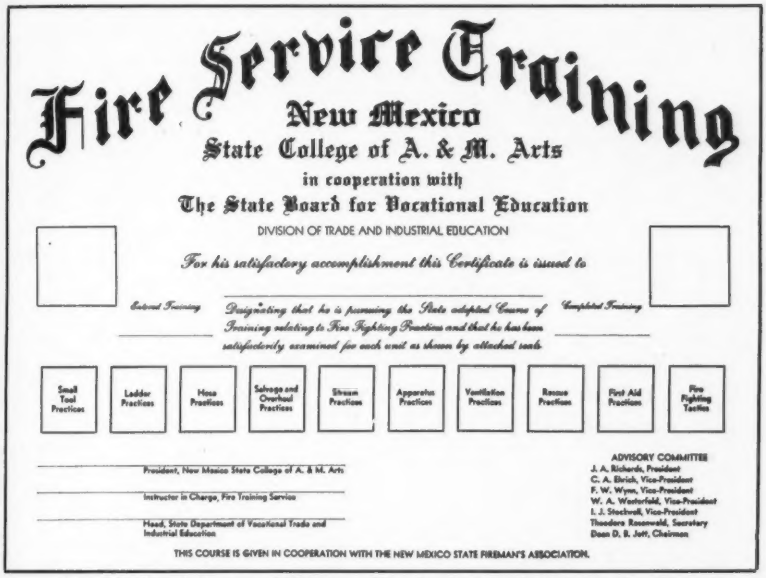
Annual short courses or fire colleges were held this year in 24 states and 2 Canadian provinces. In many states the annual short courses are tending to become schools of advanced training. The course frequently includes conferences of instructors, fire marshals and other groups.

Annual Short Courses.

	Years Held	Departments Represented	1942 Attendance
Alabama	7	19	58
British Columbia	11	32	104
Colorado	12	43	457
Connecticut	2	—	—
Georgia	8	57	537
Illinois	18	182	602
Indiana	9	114	742
Iowa	18	114	429
Kansas	13	89	140
Kentucky	5	45	163
Louisiana	13	45	75
Maine	3	14	65
Michigan	14	83	252
Montana	3	16	16
New Hampshire	—	—	—
New Jersey (Bergen County)	5	22	146
New Mexico	13	34	132
New York (for chiefs)	—	201	201
North Carolina	28	86	329
Oklahoma	10	39	62
Ontario	4	35	154
Oregon	—	—	—
Pennsylvania	4	123	387
South Dakota	13	68	482
Texas	13	258	431
West Virginia	12	51	160
Total		1,770	6,124

In addition to the annual short courses which are mostly held on a state-wide basis, regional or district short courses were held in at least sixteen states or provinces. However, this type of course is expected to be on the decline, as the state training programs are being developed to take definite comprehensive training programs direct to the local departments by means of field instructors, zone schools or by local drillmasters who have received teacher training and have qualified at a state fire school.

The feature that has distinguished the development of firemen's training programs in recent years has been the development of definite measured



Fire Service Training

New Mexico

State College of A. & M. Arts

in cooperation with

The State Board for Vocational Education

DIVISION OF TRADE AND INDUSTRIAL EDUCATION

For his satisfactory accomplishment this Certificate is issued to

Entered Training — Completed Training

Designating that he is pursuing the State adopted Course of Training relating to Fire Fighting Practices and that he has been satisfactorily examined for each unit as shown by attached seals

Small Tool Practices | Ladder Practices | Hose Practices | Salvage and Overhaul Practices | Stream Practices | Apparatus Practices | Ventilation Practices | Rescue Practices | First Aid Practices | Fire Fighting Tactics

President, New Mexico State College of A. & M. Arts

Instructor in Charge, Fire Training Service

Head, State Department of Vocational Trade and Industrial Education

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THIS COURSE IS GIVEN IN COOPERATION WITH THE NEW MEXICO STATE FIREMAN'S ASSOCIATION.

New Mexico, Arkansas, Oklahoma, Maryland and other states give firemen a certificate like this to indicate their progress in the prescribed course of training. Seals are added to the certificate as subject-units in the course are completed.

courses of instruction which may be referred to as comprehensive firemen's training courses. More than 72,000 firemen are known to have completed one or more units of training in these comprehensive courses which are now given in at least 24 of the 48 states and in 2 provinces.

The comprehensive courses might be termed the backbone of a systematic firemen's training program. These programs are in general directed by the state department of education, usually through its vocational division. They are designed to give each fireman a well-rounded training. Each course covers a certain number of major subjects or teaching units. A fireman gets credit as he qualifies for each unit. Upon completion of the entire course, each man receives a certificate from the state authorities sponsoring the course.

A good example of a comprehensive training course is that conducted in Oklahoma. In that state the individual fireman first takes a 10-hour introductory training course. He is then ready to begin work on the first of the 15 unit courses totaling 538 hours of instruction. It is not expected that the average student will complete this entire amount of training in any one year. He may complete only one unit each year. The first four units (1) Forcible Entry and Minor Extinguishment Practices, (2) Ladder Practices, (3) Hose Practices, (4) Salvage and Overhaul Practices, give the firemen training in funda-

Comprehensive Training Courses.

	Total Hours in Course	No. Units in Course	No. Units in Which Instruction Was Given 1941-1942	Departments Represented in Classes	No. Men Completing One or More Units 1941-1942
Alabama	30	4	4	19	—
British Columbia (given at annual short course)	40	10	10	—	—
California	—	—	—	—	—
Colorado	10	—	—	43	192
Connecticut	—	—	—	—	—
Delaware	—	—	—	—	—
Indiana	240	12	8	246	6,184
Iowa: Introductory	25	—	—	31	550
Standard	60				
Kentucky	18	5	5	—	101
Louisiana (regional schools)	40	12	12	97	568
Maryland: Basic	75	25	25	47	370
Advanced	69	23	23	18	114
Massachusetts (local schools)	—	—	—	36	1,243
Michigan: (Town schools)	24	12	12	—	720
(City schools)	—	—	—	10	425
Missouri	32	5	5	—	8,549
Montana	40	6	6	16	69
Nebraska	546	27	—	35	846
New Hampshire	—	—	—	—	—
New Jersey	84	42	42	18	48
New Mexico: Introductory	10	1	1	—	272
Advanced	10-20	—	—	18	192
New York	—	—	—	—	34,700
Ohio	40	20	20	51	925
Oklahoma: Advanced	360	12	6	14	942
Ontario	40	—	—	80	2,142
Pennsylvania	45	6	6	226	2,375
(Western)	30	—	—	63	240
South Dakota	40	8	8	—	—
Utah	37	6	6	2	27
West Virginia	60	6	6	24	303
Total				1,094	62,097

mental operations. Subsequent units are designed to train men as skilled fire fighters and prepare them to become officers.

In addition to the types of training previously discussed, 19 states and the provinces of Ontario and Quebec employ field instructors to give elementary training to fire departments not reached by other forms of training. This instruction is tabulated in accompanying tables in addition to that which field instructors may have performed in conducting comprehensive or regional training courses. A total of 988 fire departments are reported to have received an average of 2 to 30 hours of instruction in the various states.

Programs in the several states are summarized in brief paragraphs following and in the accompanying tables.

Regional or District Short Courses.

(One Day to Two Weeks Training)

	No. Schools	Departments Represented	1942 Attendance
Georgia	2	8	250
Illinois	55	1,184	3,200
Indiana	5	77	1,031
Iowa	10	153	831
Kentucky	1	5	25
Missouri	10	186	1,061
Nebraska	9	246	1,100
New Jersey	6	6	240
North Dakota	6	78	576
Ohio	1	10	375
Ontario	2	57	251
Pennsylvania (Western)	1	51	250
Tennessee	2	42	156
Vermont	6	6	130
Washington	15	187	935
Wisconsin	1	12	39
Total	132	2,308	10,450

Teacher Training Conferences.

Alabama—Seventy men, including forty from the Birmingham Fire Department, attended instructors' classes.

British Columbia—Ten men attended a conference for instructors.

Colorado—A total of 323 men attended instructors' classes.

Connecticut—Monthly meeting of drillmasters.

Florida—Several instructor training schools to be held this autumn.

Indiana—Thirteen instructor conferences were held, with a total attendance of 682 men.

Iowa—Thirty-four representatives from six departments attended instructor training classes.

Kansas—Two hundred men attended four instructor training conferences during February.

Kentucky—Fourteen men attended a 12-hour instructor training conference.

Maine—Representatives of sixteen counties attended a training conference for instructors.

Maryland—Twenty-hour job analysis conference attended by 25 instructors. A training conference on war gases and incendiaries was attended by 261 men from 144 departments.

Massachusetts—Monthly meetings of instructors were continued. In addition, a 10-day conference was held to study standard practices.

Michigan—One hundred and sixty-three men attended two instructors' classes.

New Hampshire—Zone schools for the training of instructors have brought the state training program to 6,600 members of 97 fire departments.

Oklahoma—A week's teacher-training to qualify new instructors was followed by a week-long course for instructors of rescue practices. Fourteen instructors attended.

Ontario—Forty-two men attended instructor conferences.

Pennsylvania—Forty-seven men attended training conferences conducted by Public Service Institute. Sixteen men attended instructors' conference reported by Western Pennsylvania Firemen's Training Institute.

Total attendance reported for the above instructors' conferences was 1977.

Work of Field Instructors.

(Additional to Comprehensive or Short Courses)

	Average Hours Instruction	No. Departments Visited	Total Men Reached
Alabama	5	6	46
Arizona	15	14	398
Georgia	6	15	900
Illinois (courses at military posts)	8	25	500
Iowa	25	11	175
Kentucky	20	23	498
Maryland	—	144	2,082
Missouri	5	90	1,800
Montana	18	1	24
Nevada	12	20	569
New Mexico	10-20	18	192
New Jersey (Bergen County)	6	20	1,467
Ohio	2	51	925
Oklahoma	20	12	689
Ontario	2	19	219
Pennsylvania	—	—	575
Quebec	5	260	5,200
Tennessee	—	—	—
Texas	—	—	—
Virginia	30	36	2,839
Washington	5	223	3,200
Total		988	22,298

Work of Local Departmental Instructors Trained Under the State Program.

(Representative figures from states which reported on this feature.)

	No. Men
Alabama	650
Indiana	1,950
Iowa	4,200
Kentucky	500
Montana	200
New Hampshire	6,600
Oklahoma	750
Ontario	3,000
Virginia	700
Washington	3,000
Total	21,550

Summary of State and Provincial Activities.

Alabama.

58 men from 19 cities attended the 7th annual short course. 70 men, including 40 from the Birmingham fire department, attended instructors' classes.

Men from 19 departments were represented in the 30-hour, 4-unit comprehensive course.

In addition, 6 departments were visited by a field instructor and 46 men received an average of 5 hours' training.

Local drillmasters, trained under the state program instructed approximately 650 members of 29 fire departments.

Beginning September 1, 1942 Battalion Chief W. M. Walton of the Birmingham fire department has been employed by the Trades and Industrial Education Division of the University of Alabama, as full-time instructor in Fire Defense Training.

Arizona.

398 firemen from 14 departments were given a 15-hour training course during the year by field instructors.

Arkansas.

Regional fire schools will be discontinued for the duration and will be replaced by departmental training. The "Introductory Course Manual" is being revised.

British Columbia.

104 firemen from 32 departments attended the 11th annual fire school. These men completed a 10-unit, 40-hour training course. A new correspondence course in firemen's training is being started as an experimental training project. Ten men attended teacher's training course.

Colorado.

457 firemen from 43 departments attended the 12th annual short course. 323 men attended instructors' classes.

192 men from 43 departments completed the 10-hour comprehensive training course.

Connecticut.

The 2nd annual fire college was held in June at New Britain.

Florida.

The 1942 Florida State Fire College has been discontinued for the year due to war conditions.

The fire departments of the state are doing an increased amount of local training, including the training of auxiliary firemen.

The state is making plans through the Trades and Industrial Education Division of the State Department of Education to conduct several instructors' training schools before the end of this year.

Georgia.

537 firemen from 57 departments attended the 8th annual State Fire College at Atlanta during May.

250 firemen from 8 departments received training at regional short courses.

Field instructors visited 15 departments and 900 men received an average of 6 hours' instruction.

Illinois.

602 firemen from 182 departments attended the 18th annual fire school.

55 regional or district firemen's training schools held since January 1 had an attendance of 3,200 firemen from 1,184 departments. Basic and advanced schools are being held in 35 regions of 9 districts of the state.

In addition to work at regional schools, the 4 full-time training instructors gave 8 hours' instruction to 500 fire fighters at 25 military posts.

Indiana.

742 men from 114 cities attended the 9th annual short course.

682 men attended 13 instructors' conferences.

A total of 6,184 men from 246 departments completed one or more of 8 units given this year as part of the 12-unit, 240-hour comprehensive training course.

1,031 men from 77 departments attended 5 district short courses.

In addition, 1,950 men received training in local classes conducted by fire department drillmasters trained under the state program.

A total of 10,589 firemen have received instruction from the Indiana firemen's training program thus far in 1942.

Iowa.

429 men from 114 departments attended the 18th Iowa Fire School held at State College at Ames, June 23-26.

34 men from 6 departments attended instructor training conferences.

550 men from 31 departments completed one or more units of either the 25-hour introductory course or the 60-hour standard training course.

831 men from 153 departments participated in 10 regional training schools.

Field instructors visited 11 departments giving an average of 25 hours' instruction to 175 men. In addition, about 4,200 firemen received training from departmental schools conducted by drillmasters trained under the state program. Thus, a total of 6,219 firemen received training through the state program.

Kansas.

Fire school, held September 21-23 in conjunction with the annual convention of the League of Kansas Municipalities, is primarily devoted to fire defense. 140 men from 89 departments were in attendance.

During February four instructor training conferences had an attendance of 200 men.

Kentucky.

163 firemen from 45 departments and from Fort Knox attended the 5th annual fire school.

14 men attended a 12-hour instructors' conference.

101 men attending the fire school received certificates for completing one or more units of the 5-unit, 18-hour comprehensive course.

25 men from 5 departments attended a regional short course.

498 men in 23 departments were given an average of 20 hours' instruction by field instructors. This was in addition to defense training given in 201 cities by 27 instructors.

Approximately 500 firemen also received training in local departments from instructors trained by the state program. Five other departments having their own drillmasters conducted local programs.

A four-day training school for fire marshals and inspectors was held at Frankfort in September by the State Fire Marshal.

Louisiana.

75 firemen from 45 departments attended the 13th annual fire school.

568 men from 97 departments completed one or more units of the 12-unit, 40-hour comprehensive course given at 21 regional fire schools. These courses conducted by instructors trained under the state training program averaged 15 hours of instruction per man during the year.

Maine.

65 men from 14 departments attended a 3-day short course at Presque Isle.

A teacher-training course for defense instructors was held at Augusta, with representatives of 16 counties in attendance.

Maryland.

The 13th annual fire college was not held, due to the war emergency. Instead, a 20-hour job analysis training conference was held during September with 25 men in attendance.

During the year, 370 firemen from 47 departments completed one or more units of the 25-unit, 75 hour basic training course. 114 firemen from 18 departments completed one or more units of the 23-unit, 69-hour advanced course.

In addition, regional classes were held throughout the state to train 261 instructors from 144 companies in the subjects of war gases and incendiaries. These classes consisted of 24 hours of instruction. The instructors then taught classes with a total of 2,082 regular firemen. Auxiliary firemen and wardens were subsequently instructed.

Massachusetts.

1,649 men attended 46 training courses conducted by field instructors in 36 municipalities. 1,243 men completed this training. No zone schools were held during the year.

During the past year regular monthly meetings of fire department instructors were held and in addition a 10-day session was devoted to the study of standard practices.

A modern fire department drill tower. This one belongs to the Toledo, Ohio, Fire Department, is 20 feet square and 65 feet high.

Michigan.

252 men from 83 departments attended the 14th annual fire school. Of these, 189 received certificates, indicating completion of the course.

163 men attended two instructors' conferences.

425 men from 10 paid fire departments and 720 men from volunteer departments received training in courses conducted by certified instructors. Twelve-meeting courses were held at 36 schools.

Mississippi.

No state-wide training program was conducted, due to war conditions. Many departments, however, have been training new men, but no figures are available covering this work.

Missouri.

Both the Missouri Central and the Southeast Missouri Fire Schools were postponed this year in order to devote more time to the training of auxiliary firemen. However, during the year, 8,549 men were given a 32-hour, 5-unit training course by local instructors previously trained in the state program. In addition, field instructors visited 90 departments and gave from 2 to 5 hours' training to 1,800 men, and 1,061 men from 186 departments attended ten 1-day district short courses.

Montana.

Representatives from 16 departments attended the third annual fire school. In addition, 69 members of 16 departments completed one or more units of the 6-unit, 40-hour training course. An 18-hour instruction course was given to 24 firemen by a field instructor. Departmental schools trained an additional 200 men.

Nebraska.

846 men from 35 fire departments completed one or more units of the comprehensive training course. The entire course consists of 27 units, with 546 hours' instruction.

In addition, more than 1,100 men from 246 departments attended 9 regional fire schools.

Nevada.

Field instruction work given at 20 departments provided an average of 12 hours' instruction for 569 men.

New Jersey.

The 6th annual short course was held by the New Jersey State Fire Schools' Council with representatives of 9 counties in attendance. 45 men attended instructors' conferences. 48 men from 18 departments completed one or more units of the 42-unit, 84-hour comprehensive course which was given at five fire schools. Short courses were given 6 departments with 240 men in attendance.

Chief George P. Lasher of Edgewater reports that in Bergen County 146 men from 22 departments attended the 5th annual fire school and completed one or more units in a 20-hour course. 10 men attended an instructors' training conference. Field instructors gave an average of 6 hours' instruction to 1,467 men in 20 fire departments, industrial fire brigades and civilian protection groups. Approximately 310 other firemen received training in local drill schools.

New Mexico.

132 firemen from 34 departments attended the 13th annual fire school.

192 men from 18 departments completed one or more units in the 10 to 20-hour comprehensive training course given by the field instructor during the first six months of the year. In addition, the 10-hour introductory course was given to 272 auxiliary firemen.

New York.

For the fiscal year ending June 30, 34,901 firemen received training under various phases of the state's firemen's training program. According to the Office of War Training Programs, State Department of Education, 21,000 firemen, mostly volunteer firemen, were trained by the fire training program of the New York State War Council. Another 13,700 firemen were trained by the Municipal Training Institute of New York State and 201 fire chiefs attended training programs conducted by the Institute.

North Carolina.

The 1942 North Carolina Fire College and Drill School was held at Asheville, June 2-4, with 329 men from 86 cities, towns, Army bases and industrial plants in attendance. Of the men attending, 283 qualified for 1942 fire college certificates and 277 received drill school certificates. Of the 227 men receiving drill school certificates, 100 qualified for advanced drill school certificates for the 1942 season. Eleven men received diplomas for having completed four full sessions of the fire college and drill school.

The North Carolina program of fire department personnel training is the oldest statewide firemen's training program in the United States, having been initiated in 1914, following endorsement by the North Carolina Firemen's Association.

With the entrance of the United States into war a special meeting, attended by representatives of most of the fire departments in the state, was held in the House of Representatives of the State Capitol in Raleigh on December 10, to give attention to fire defense and training measures. Subsequent war critiques were held at Farmville, January 13, and Charlotte, on March 16, with a curriculum of fire department training supplemented by special defense training.

North Dakota.

Six regional fire schools were held with 576 men from 78 fire departments in attendance.

Ohio.

In the fiscal year ending June 30, 925 firemen from 51 departments completed one or more units of the 20-unit, 40-hour training course. This training work was carried on by three field instructors. In addition, one firemen's training short course was held, with 375 men from 10 departments in attendance.

Oklahoma.

A month's program of firemen's training was conducted at Oklahoma A. & M. College during August. This included teacher-training and instructors' courses in rescue practices. Unit courses in ladder practices, hose practices, forcible entry and minor extinguishment practices, salvage and overhaul practices, and inspection practices completed a month's training program.

Sixty-two men from 39 departments attended the 10th annual short course. Fourteen instructors attended teacher training courses. A total of 942 men from 14 departments completed one or more of the six training units of the comprehensive course given during 1942. The complete course consists of 12 units, with a total of 360 hours of training. This does not include introductory training, teacher training and supplemental training.

Field instructors visited 12 departments and gave an average of 20 hours of instruction to 689 men. In addition, local drillmasters trained in the state program conducted training courses for 750 members of their own local departments.

Ontario.

154 firemen from 35 departments attended the 4th annual fire school. 42 men attended instructor training conferences.

A total of 2,142 men from 80 fire departments completed a 40-hour comprehensive training course.

251 men from 57 departments attended two regional fire schools and field instructors gave an average of two hours' training to 219 members of 19 fire departments. In addition, 3,000 firemen received training in local fire department schools, making a total of 5,766 firemen participating in the provincial training programs during the year.

Oregon.

Oregon figures are not yet available.

Pennsylvania.

387 men from 123 departments attended the 4th Annual Fire School at State College. In addition, 2,375 men from 226 departments completed one or more units of the 45-hour, 6-unit comprehensive training course and 575 men received training at local drill schools under instructors previously trained in the state program. These figures do not include 14 classes held at various military depots. Also 47 men attended instructor training conferences.

During September the first annual short course of the Western Pennsylvania Firemen's Training Institute had an attendance of 250 men from 51 departments. In addition the Institute reports that 240 men from 63 departments completed one or more units of a 30-hour comprehensive course given by field instructors; 16 men attended an instructors' conference; and 23 members of 8 industrial fire brigades received training.

Quebec.

Representatives of the Provincial Fire Marshal's Office visited 260 fire departments and gave an average of 5 hours of instruction to about 5,200 firemen.

Rhode Island.

No firemen's training program was carried on in this state.

South Carolina.

Chief A. McMarsh of Columbia reports that, due to the war, plans for a fire school program have been postponed.

South Dakota.

482 men from 68 fire departments attended the State Fire School held at Watertown, June 1-5. These men received instruction in an 8-unit, 40-hour training program.

Tennessee.

156 firemen from 42 departments attended two regional fire schools during 1942.

Texas.

431 firemen from 258 departments attended the 13th annual fire college at College Station.

In addition, many local departments received training from the field instructor working throughout the year.

Vermont.

130 firemen from 6 departments received training in local short courses.

Virginia.

The League of Virginia Municipalities reports that field instructors visited 36 departments, and 2,839 men, including defense groups and auxiliary firemen, were given 230-hour training courses.

In addition, an estimated 700 firemen received training from drillmasters trained under the state program.

West Virginia.

160 men from 51 departments attended the 12th annual fire school.

303 men from 24 departments completed one or more units of the 6-unit, 60-hour comprehensive training course.

In addition, plant protection schools were conducted at Morgantown, June 18-19, with 115 men enrolled; and at Charleston, February 12-13, with 130 men enrolled.

Washington.

The 12th annual fire school was postponed because of the war. However, 15 regional or district training courses were conducted, with 935 men in attendance from 187 cities. In addition, field instructors visited a total of 223 departments and gave an average of 5 hours of instruction to 3,200 firemen. Another 3,000 firemen were trained in local schools conducted by drillmasters qualified under the state program. Thus, a total of 7,135 received training in this year's program.

Wisconsin.

The annual fire school was not held this year and has been discontinued for the duration. Also, the full-time fire instructor, employed by the State Department of Vocational and Adult Education, was transferred to civilian defense work. However, it is hoped that an adequate firemen's training program may be started soon as part of the OCD effort. One regional fire school has already been held with 39 firemen from 12 departments in attendance. More schools are planned.

Wyoming.

No state firemen's training work carried on in 1942.

Air Raid Precautions for Oil Storage.

The subject of air raid precautions for oil tanks was first discussed at the 1939 Annual Meeting of the Association when Member George F. Prussing of California called attention to certain fundamental aspects of this problem which was then beginning to receive attention from N.F.P.A. members who were anticipating the war. Mr. Prussing brought out the fact that the placing of oil tanks in a closely spaced group would involve far greater danger of complete destruction than would tanks in separate locations, thus minimizing the exposure to a single bomb attack or ensuing fire. Mr. Prussing said that the destruction of oil by fire might have an even more important effect on defense by reason of the loss of fuel than might the spread of fire from the conflagration standpoint, though both are important.

British Experience.

Subsequent experience during actual air raids in England and on the Continent has shown that gasoline and oil tanks are a frequent target of bombing attacks, but that where tanks are properly installed to meet peace time fire safety standards, as exemplified in the N.F.P.A. Suggested Ordinance on Flammable Liquids, the spread of fire from tank to tank is not a major factor. Information as to the technical details of the results of bombing raids on British oil storage facilities is limited and there is, in any case, some question as to whether British experience would prove an adequate guide to the protection of oil storage in North America, where gasoline and fuel oil are used and stored in much greater volume.

Effect of Incendiaries.

It is clear that the small magnesium incendiary bombs of the type used by the Germans over Britain are not of themselves likely to cause ignition of standard gas-tight tanks; at least there is no report that this type of incendiary has had any material effect upon oil tanks in Britain. Reports are lacking as to any experience with newer types of German incendiaries, but it appears likely that any incendiary bomb of relatively small size would not itself start a fire in a large oil tank because the bomb would be well below the surface of the oil before its igniting mechanism operated.

High explosive bombs obviously constitute a severe hazard to tanks. A direct hit of a large explosive bomb would be likely to rupture the tank or cause leakage. Fragments of an exploding bomb that landed outside of the tank might also be expected to puncture the shell and cause leakage. Such experience

has been definitely reported from Britain. However, the high explosive bomb, whether a direct hit or not, would presumably not itself cause ignition, and fire would result only from the subsequent dropping of incendiaries or from some other source of ignition. In the case of gasoline and similar low flash point products, the escape of any large quantity of liquid is commonly followed by fire because there are so many potential sources of ignition.

Apparently the only practicable method of completely safeguarding oil storage against bomb attack is through the use of underground tanks. It is obviously impracticable to do away with above-ground storage, and various N.F.P.A. members have expressed concern about this problem. There have been various questions about measures that may reasonably be taken to minimize the danger to above-ground oil tanks in the case of air raids.

Precautions in American Cities.

To secure information on this subject the N.F.P.A. Executive Office has made inquiry of a representative group of fire departments in order to secure information as to how this problem is being handled in various parts of the country.

The replies received from 76 fire departments located across the United States disclosed a widespread concern and indicated a generally intelligent and constructive approach to the various phases of the problem. The status of oil tank protection, as might be expected, varies considerably in different cities, depending upon local conditions, the character of municipal regulations in effect prior to the war emergency and the degree of public concern about the danger of air raid fires.

The results of this inquiry are summarized below. Out of the 76 replies received, seven came from fire departments whose city ordinances prohibited above-ground gasoline storage, and two wrote for further information, but without replying to the original inquiry. This leaves 67 who replied to one or more of the eight questions asked.

Statistical Summary — Fire Department Inquiry.

1. In case of bombing do all tanks have adequate dikes to prevent spread of burning gasoline or oil to surrounding property?

YES		NO		
% of those who answered question	Number	% of those who answered question	Number	
66.6	44	15.1	10	
12.2	8 "nearly all"	—	1	did not answer
6.1	4 "some"			
84.9%	56	15.1%	11	

52 cities (78.8%) have practically 100% dike protection. 10 cities (15.1%), or one in every seven, have made no dike protection, and 4 cities (6.1%) have "some" protection.

2. Have tanks been taken out of service when dikes cannot be provided because of local conditions and where important local defense industries are exposed?

YES			NO		
% of those who answered question	Number		% of those who answered question	Number	
18.3	11		36.7	22	
20.0	12	"properly diked"	—	7	did not answer
15.0	9	"no such condition"			
3.4	2	"no important exposures"			
3.3	2	"all tanks that are exposed"			
3.3	2	"some"			
63.3%	38		36.7%	29	

27 cities, or 44.9%, had made provision to protect exposed property. 33 cities, or 55%, had taken no tanks out of service, eleven of them claiming "no such condition existed," or that there were "no important exposures."

3. Has provision been made for emergency repair of dikes injured in bombings by keeping on hand a supply of bags of earth?

YES			NO		
% of those who answered question	Number		% of those who answered question	Number	
28.1	16		50.9	25	
10.5	6	"partial"	1.8	1	"contemplated"
5.2	3	"in process"	1.8	1	"recommended"
			1.7	1	"discussing with oil companies"
			—	10	did not answer
43.8%	25		56.2%	42	

Over 50% of the cities had made no provision for keeping bags of sand on hand to make emergency repair of tanks.

4. How are rain water drains from diked areas protected against escape of oil?

YES			NO		
% of those who answered question	Number		% of those who answered question	Number	
10.9	6	no comments	10.9	6	no comments
38.2	21	"by valves, pumps, traps, vents, automatic control system, separators, sluices	29.1	16	"no rain water drains"
			—	12	did not answer
7.3	4	"some"			
3.6	2	"not connected"			
60.0%	33		40.0%	34	

27 cities (49.1%) had taken adequate measures to protect rain water drains from escaping oil; 4 additional cities (7.3%) had "some" protection. But 16 cities had no rain water drains. 6 additional cities had made no provision for protection.

5. Are valves at tanks kept closed when no oil is being delivered or withdrawn so as to minimize the danger from broken pipes?

YES		NO	
% of those who answered question	Number	% of those who answered question	Number
89.5	51	3.4	2
5.3	3 "not all cases"	—	10 did not answer
1.8	1 "at night only"		
96.6%	55	3.4%	12

This is practically 100% protection.

6. Have tanks been checked to see that they have adequate emergency vents to prevent explosion from internal pressure?

YES		NO	
% of those who answered question	Number	% of those who answered question	Number
93.4	57	6.6	4
		—	6 did not answer
93.4	57	6.6%	10

This is practically 100% protection.

7. Have exposed steel supports of elevated tanks been protected with brick or cement to prevent collapse when exposed to fire?

YES		NO	
% of those who answered question	Number	% of those who answered question	Number
39.0	23	17.0	10
22.0	13 "no steel supports"	—	8 did not answer
22.0	13 "some"		
83.0%	49	17.0%	18

One out of every 6 cities has not protected exposed steel supports of elevated tanks with brick or cement.

8. Has provision been made in case of air raids to drive tank trucks to locations where they would not endanger important property if ignited?

YES		NO	
% of those who answered question	Number	% of those who answered question	Number
59.0	36	26.2	16
9.8	6 "partial"	1.7	1 "under discussion"
1.7	1 "emptied at night"	1.6	1 "regulations prohibit"
		—	6 did not answer
70.5%	43	29.5%	24

16 cities (26.2%) have made no provision to drive tank trucks from the vicinity of above-ground tanks in case of bombing.

The questions selected for this fire department inquiry were chosen for the purpose of disclosing to what degree the most reasonable protective measures which had been gleaned from experience had been put into effect or were in process of realization in the United States.

While there is not much technical information available on the results of enemy bombing of oil storage facilities in Britain, our inquiry clearly shows we have not taken advantage of some of this available experience.

Particularly is this true in the inadequacy of sand bag barriers, as the quickest, most effective and economical method of repairing damaged dike banks, and for the protection of pump houses. Over fifty per cent of the cities interrogated had made no provision for their use.

It is quite natural that more of our tanks have not been taken out of service when dikes cannot be provided for their protection nor for the protection of exposed defense industries. But if raids should materialize, Britain's experience of retiring some tanks in closely bunched installations and filling them with water to serve as a fire stop, will be worth remembering. Britain has also minimized the danger of escaping oil from diked areas by providing drains to sumps from which spilled oil can be pumped to other tanks.

International.

Midland Boat Works Fire.

Moloch, the God of Fire, has little regard for the urgencies of Mars when the latter fails to observe essentials of fire safety. This is well demonstrated by the above fire at the Midland Boat Works, Midland, Ontario, which destroyed this shipyard and two small Canadian war vessels under construction according to information obtained from W. J. Scott, K.C., Fire Marshal of the Province of Ontario. A small shack filled with shavings and other combustibles served as the boiler room. No first-aid fire appliances were available and no private fire brigade crews had been trained to protect this unsprinklered plant when, on the windy evening of July 14, a boiler backdraft blew sparks into scrap wood and shavings. Employees near by quickly discovered the fire and could have extinguished it had fire equipment been at hand. Unfortunately, however, the plant management was reportedly so interested in the production of boats for the Navy that protection against fire was completely overlooked. The 78-year-old night watchman was sweeping the plant office when the fire was discovered. Fortunately the adjacent plant of the Midland Ship Yards, Ltd., had a well-trained and equipped fire brigade which prevented the spread of the fire in their direction, preventing loss which might have been much more serious.

Fatal Crash at Airplane Plant.

By Chief George E. Walsh,
Fire Prevention Bureau, Buffalo Fire Department.

There are very few fires which to the mind of a fire protection engineer may be classified as "unpreventable" or described as an "act of God." However, one case closely approaching this category was the tragedy that took fourteen lives when a burning plane crashed through the roof of the Curtiss-Wright Airplane Division plant at Cheektowaga near Buffalo, New York, on September 11. According to reports appearing in the press, a test pilot was putting a P-40 pursuit plane through its paces at a high altitude, when flames broke out. Heading the plane toward open country, the pilot was forced to bail out at approximately 20,000 feet. In some unexplained manner the falling plane reversed its direction of flight and plunged through the roof of the plant. Two men were instantly killed, while twelve others were fatally burned by flaming gasoline released from the wrecked plane. In addition, 44 men and two women employees suffered burns and other injuries. One wing of the plane remained on the roof, but the motor and fuselage fell into the building and struck the concrete floor.

Description of the Plant.

The building was a one-story structure of brick, concrete and steel construction, consisting of one very large fire area. There was no basement under the section where the crash and fire occurred. The department into which the plane crashed consisted of a 30 by 60-foot area surrounded by an iron grill fence, and was located in the northwest corner of the building. The fire caused by the burning plane was confined to an area approximately 40 feet square.

Story of the Fire.

When the plane crashed through the roof, gasoline released from the fuselage tank caused an extremely hot fire. Plant employees immediately sounded the alarm over three private fire alarm boxes and 90 members of the plant fire brigade responded and did excellent work in extinguishing the fire. They were aided by the operation of 208 automatic sprinkler heads on a wet-pipe system. Fortunately, the falling plane had not seriously damaged the sprinkler piping, although a 1¼-inch sprinkler pipe and a 6-inch commercial water service line suspended from the ceiling were ruptured. These pipes released considerable quantities of water, which flooded a large area. The plant engineer on duty upon hearing the crash immediately consulted the water pressure gauge and noticed that the pressure had dropped to twenty pounds. He started the 1500 g.p.m. electrically driven fire pump and started to warm

up the 1500 g.p.m. steam turbine pump which was placed in operation. A pressure of 75 pounds per square inch was maintained at both pumps.

Equipment used by the plant fire brigade included 191 2½-gallon foam extinguishers, six 40-gallon foam extinguishers, two 75-pound carbon dioxide extinguishers, and three lines of 2½-inch hose with 1⅛-inch nozzle tips. The hose lines were supplied by standpipe connections. The prompt application of the foam and carbon dioxide was helpful in preventing the gasoline burning on the surface of the water from spreading the fire. It is estimated that the fire was under control in 15 minutes and was completely out in 30 minutes.

The fall of the blazing plane was observed by members of Engine Co. 7 of the Buffalo Fire Department, stationed at the Buffalo Airport. This company, assuming that the plane would fall in a field beyond the building, responded at 5:15 P.M. with a crash truck equipped with foam and carbon dioxide equipment, and with a 1000-gallon pumper. Neither piece of apparatus was used, but the fire company rendered valuable service in manning one of the private standpipe hose streams, removing the injured to the first aid station, pumping out the flooded area below the ground level, and in covering the damaged roof.

When leaving quarters to respond to the fire, the officer in charge of Engine Co. 7 directed the airport electrician, who is an auxiliary fireman, to notify the Buffalo fire alarm office of the incident. The chief of the 5th battalion responded at that time, but the fire was out upon his arrival.

While the loss of life resulting from this accident is very unfortunate, the fire emphasizes the importance of having a well-trained fire brigade ready to meet any such emergency. The value of automatic sprinkler protection in the protection of industrial plants was again demonstrated.

Synthetic Rubber.

By Gerald W. Hallowell.

The search for synthetic rubber naturally began by analyzing natural rubber. John Dalton, who discovered the atomic law, and Justus von Liebig, the founder of agricultural chemistry, tried to analyze rubber and failed. In 1826 Michael Faraday almost found the right answer. Twenty years later, Himly, an obscure German chemist, isolated two liquids from natural rubber. From his records we know that he succeeded in isolating the parent substance of natural rubber, but he did not realize what he had discovered.

ISOPRENE. In 1860 Greville Williams, an Englishman, isolated from natural rubber by dry distillation a liquid, which he called isoprene. It boiled at 98.6° F. He found it to be hydrocarbon, the molecule containing 5 atoms of carbon and 8 of hydrogen. When distilled it became thick and viscid, eventually solidifying into an elastic mass much like rubber.

The chemical name for isoprene is 2 methyl butadiene or 2 methyl divinyl. It is one of the simpler members of the diolefin family, that is, a member of the hydrocarbon family having two double bonds. Natural rubber is simply a series of giant isoprene molecules linked together.

It was not until 1882 that synthetic rubber was actually discovered. Sir William Tilden found it quite by chance. He had left some turpentine standing in a bottle in the sunlight. Upon observing it, after standing for six months, it had turned to a thick rubbery mass. He knew what he had. He deliberately tried to work out a feasible commercial process for its manufacture. He could induce it to form rubber, but it was inferior in quality. He finally gave up, discouraged because he could discover no way to do it quickly or cheaply.

One of the peculiar things about natural rubber and its parent liquid substance, isoprene, is they both have identically the same chemical formula—5 carbon and 8 hydrogen atoms to the molecule. By constant work the chemists found that this difference was due to the different structural arrangement (or pattern) of the molecules in the gum from that of the liquid.

The Chemistry of Natural Rubber.

POLYMERIZATION. In natural rubber the isoprene molecules are polymerized, that is, joined together end to end in long chains. The individual links are called "monomers"; when joined together they form a "polymer," and the linking process is called "polymerization."

Polymerization is a fairly common phenomenon in nature. Chemists are yearly learning new ways to accomplish it in a chemical plant. It is a very tricky reaction. Slight traces of impurities throw it off the switch, stopping the chain's growth in reaction. The greater the polymerization the better are the rubber-

International.

Butadiene cannot be stored in tanks containing oxygen. This man is testing a tank at one of the butadiene plants of the Standard Oil Company of N. J. to determine its gas and oxygen content before allowing butadiene to enter it.

like qualities. The best grades of Para rubber from Brazil have about 4000 molecules hooked together; the best of the synthetics about 400.

CO-POLYMERIZATION. From learning the chemical pattern of isoprene chemists began the discovery of its relationship to other chemical groups. Furthermore, it was found that two polymerizable compounds can be hooked up together to form co-polymers. All this knowledge about the various long chain molecules has become exceedingly important in making rubber-like materials.

How the Chemist Imitates Nature.

BUTADIENE. With the growing knowledge of polymerization and the relation of isoprene to other chemical groups, rubber making focused its attention on producing butadiene (which has 4 carbon and 6 hydrogen atoms to the

molecule) in vast quantities cheaply, and then inducing polymerization. Rubber can be made directly from butadiene, but the resulting product is not satisfactory. Most of the butadiene in this country is produced from petroleum by "cracking," or from ethyl alcohol as made from corn, potatoes or molasses by fermentation. Our lush supplies both of oil and gas are the stake of the petroleum companies in synthetic rubbers made from butadiene.

The First German Synthetic Rubber.

Before the first World War, Germany, appreciating her lack of domestic supplies of either petroleum or natural gas, and that the British would unquestionably blockade her from obtaining supplies from the Far East, was forced to make her butadiene either from ethyl alcohol or acetylene. With all foodstuffs at a premium, she derived her butadiene from acetylene, that is, via calcium carbide from the hydrogen of water, and the carbon of coal and limestone. This is Germany's source today. Russia obtains her butadiene from grain and potato alcohol, and more recently from acetylene and from petroleum. It can be derived indirectly from natural gas and almost any starchy vegetable matter.

METHYL RUBBER. The Russian chemist, Kondakoff, was one of the first to recognize that by varying the conditions of polymerization reaction, different products with quite distinct properties might be obtained. He was the first to make "methyl rubber," a polymer of 2 methyl-butadiene, which is what the Germans used in the first World War. They had not gotten far with these developments when the first World War broke. They produced about 2500 tons during the war. It was not a conspicuous success because too little was known then by anyone as to how the polymerization reaction could be controlled. Sometimes all they got was a substance that resembled molasses.

When the Nazis came to power and began to rearm they did not forget their experience in World War I. They put ersatz rubber high on the list of official research projects. But in 1932, three years before their frenzied quest ended in the now famous Buna-type elastomers, two industrially successful synthetic rubbers had been produced by two Americans.

U. S. Production Policy.

These two American synthetic rubbers—Neoprene and Thiokol—with others will be described later. Since Buna S rubber has been selected for the major portion of the U. S. tire program, to be supported by the duPont Company's Neoprene, and supplemented by Thiokol and other synthetics, Buna S will be discussed first. Its properties, in almost every respect, are sufficiently similar to natural rubber to replace natural rubber for tires. Moreover, the more extended knowledge and experience in its production and performance over any other synthetic has clinched its selection in the rubber emergency which faces this country.

International.

This white mass was once just petroleum gas. Soon it will be sheet rubber ready to be cured and processed. Here it has come from a filter in one of the Standard Oil Company of N. J. plants. The squeezing removes brine, water and soap solution; part of the Buna N and Buna S processes.

It might, however, be well to point out before other promising synthetics are discussed, with their various claims and counterclaims, that the war program had to be determined at a time when the synthetic development is bringing out something new, or claiming the superiority of some method or product, almost daily.

Since speed of plant construction and production tonnage is of the essence in our rubber emergency, those in authority have determined not to change plant construction once it is under way for the selected processes, in order to

meet the requirements of some process which has not been sufficiently tested to warrant the change. There is no time to make changes.

The Baruch Report to the President strongly urged the procedure of "bulling the present program through," fully recognizing the probability that some of the newer synthetics may prove eventually superior in technique and product to those selected.

The German Buna Type Elastomers.

By 1933 (when Neoprene came out) the Germans had discovered that they could speed up the polymerization of butadiene by introducing metallic sodium. Specifically it was found that butadiene when joined with 2 methyl butadiene could be made into fairly serviceable rubber by treating with sodium.

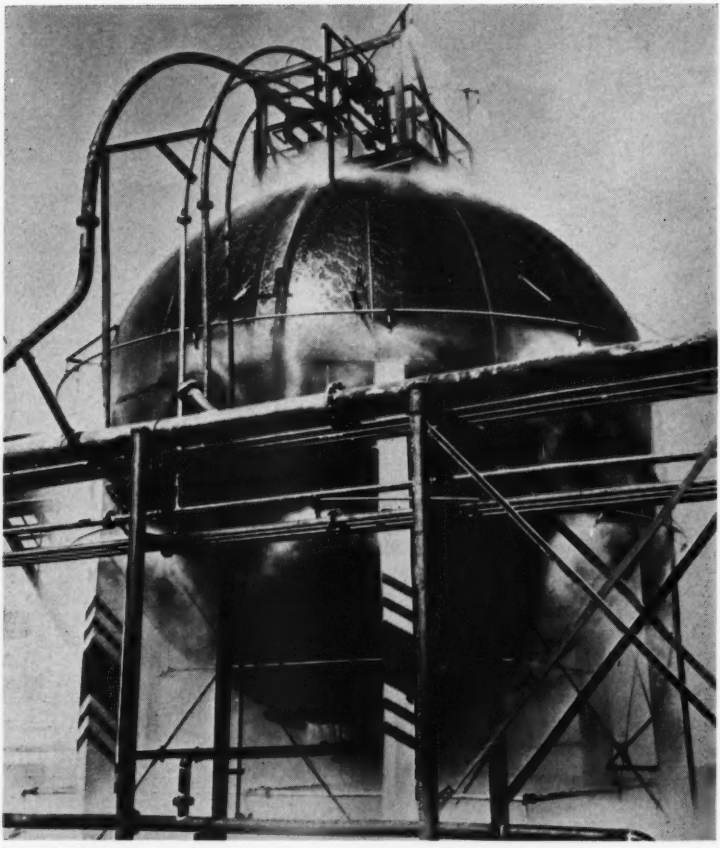
BUNA RUBBER. They termed the polymer obtained by this process Buna (the first syllable of butadiene combined with sodium, Na). This original Buna was not much better than the "methyl rubber" of the first World War. But German chemists improved it by trying out all sorts of co-polymers of butadiene with other polymerizable compounds. It was found when certain modifying agents were added to the butadiene, and a somewhat different method of polymerization was used, a new and greatly superior rubber resulted. The two modifying agents found to be most satisfactory were acrylonitrile and styrene; the former produced a synthetic rubber called Buna N; and the latter Buna S.

The German chemists Konrad and Tschunkhur were granted a U. S. patent on September 11, 1934, which covered their Buna N rubber. Buna S, a co-polymer of butadiene and styrene, followed early in 1936. Both patents were assigned to the I.G. Chemical Trust.

BUNA N (PERBUNAN). This is a specialty rubber, resistant to gas, oil, etc. It will vulcanize with sulphur just as natural rubber will and can be made to yield compounds of all degrees of hardness, ranging from soft inking roll stocks up to a very hard ebonite. Like natural rubber, Perbunan must have carbon black incorporated if high tensile strength is demanded. Any stock which is light colored is likely to have low tensile strength and the other properties may also be poor. Perbunan vulcanizates are very resistant to oils, quite resistant to heat, and have low permanent set or good cold flow resistance. It has been used as a tank lining material as it is resistant to acids, alkalis and water; its electrical properties are not outstanding, but are good enough for many purposes. It can be used for printers' rolls, motor mountings, conveyor belts, gasoline hose, packing, gaskets, etc.

From a rubber manufacturer's standpoint the chief drawback to this material is the difficulty in processing it, since it does not break down on a rubber mill in the same manner as natural rubber.

BUNA S. This is the German tire rubber, but it also can be bonded to metal, and may replace rubber as a tank pipe lining. The patents cover the best of the many co-polymers of butadiene which undoubtedly the Germans



International.

The Butadiene Storage Tank at a new U. S. Rubber Company's synthetic plant. The water spray prevents undesirable polymerization, and protects against external fire.

made experimentally. The American rights to them, in accordance with the agreement made in 1929, became the property of the Standard Oil Company of New Jersey. Much effort was made to interest the U. S. rubber companies in Buna S for tires. The Germans sent Dr. ter Meer, chief of IG's synthetic rubber department, to this country in December, 1938. Very little action resulted. American companies believed butadiene could be produced cheaper from petroleum.

Since Buna S is the kingpin of the U. S. war tire program, the processes for making butadiene and styrene from petroleum, and combining them into Buna S, will be described briefly.

BUTADIENE. One of the methods of making butadiene is to use butane, formerly a waste gas from refineries, which is catalytically dehydrogenated to butylene, and butylene to butadiene. 100 octane gasoline is obtained from butylene. On a large scale tonnage basis butadiene can be made for 10-15 cents per pound; acrylonitrile for 35 cents, and the finished Buna type rubber for 20-25 cents per pound.

STYRENE. Direct methods of making styrene from petroleum are not available, but ethylene gas and benzene can be made from petroleum. They combine readily in the presence of a catalyst such as phosphoric acid to produce ethyl benzene, which is dehydrogenated (cracked) to styrene.

ETHYLENE. Ethylene is made from two different sources in this country, as follows:

(a) It is a sizable constituent of most cracking-still gases. It can be produced in large quantities by the dehydrogenation of natural gas, or those natural gas hydrocarbons that are heavier than ethane. The ethylene tends to polymerize under these conditions, and also to produce other alkylated benzenes by side reactions or third order polymerization reactions. Hence its concentration in the reacting fluid must be kept low, perhaps to less than 10% of the volume of the reacting fluids. Yields are high under these conditions, being 95% on a mol basis.

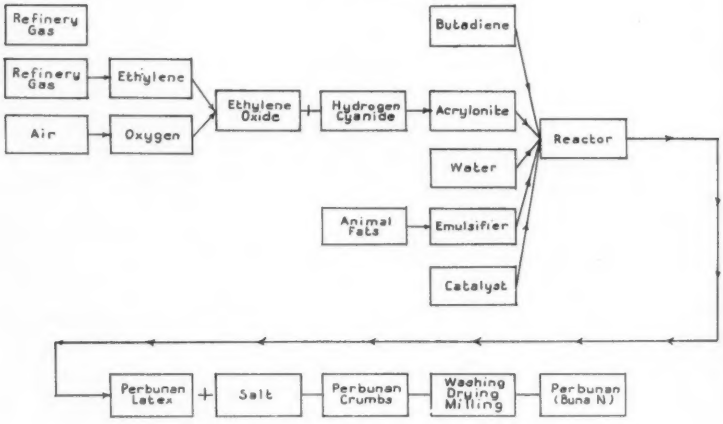
(b) Ethylene can also be produced with ease by splitting water from ethyl alcohol in a process which involves heating at 500-600° F. in the presence of phosphoric acid as a catalyst. In this process it is possible to make ethyl benzene by the direct union of alcohol and benzene at elevated temperatures in the presence of phosphoric acid, which when dehydrogenated (cracked) gives styrene.

BENZENE. Benzene is produced in enormous quantities in many refinery processes, such as the dehydroforming, polyforming or fluid catalytic processes for producing high octane gasoline.

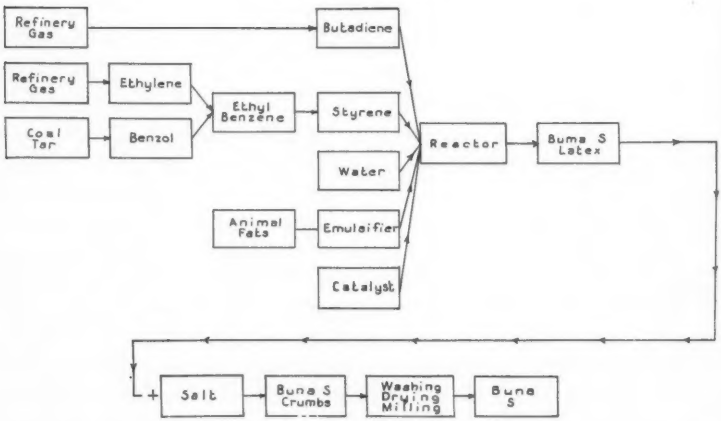
The Union of Butadiene and Styrene to Make Buna S.

Butadiene (a gas at room temperature, liquid under pressure or refrigeration) meets with styrene in the polymerization kettle, in the proportion of 3 parts of butadiene to 1 part of styrene. The emulsion process for polymerization is used. (This emulsion method has almost completely superseded the former methods which were used first by Kondakoff and the chemists following him who tried to produce polymerization by catalytic action on artificial isoprene monomers). In this polymerization kettle a soapy emulsion and catalyst are added. A slight heat causes the butadiene and styrene molecules to interpolymerize (hook-up) into a rubbery mass. The catalysts selected are usually oxidizing agents, such as hydrogen peroxide, sodium perborate, ammonium persulfate or organic peroxides or peracides. They control the hooking up process to achieve the right length of molecular chains and physical properties.

BUNA N
(Perbunan)



BUNA S
(German Tire Rubber)



ISOBUTYLENE. As a result of the same agreement between I. G. Farbenindustrie and Standard Oil, the latter had acquired technical information from the Germans on a chain polymer of the hydrocarbon isobutylene, which exhibits certain rubber-like qualities.

VISTANEX. Standard Oil introduced it in this country as Vistanex. It has found increasing use as a coating material in electrical installation work; an ingredient in high pressure lubricants to control their viscosity. It cannot be processed with rubber; it cannot be vulcanized.

Standard Oil's Butyl Rubber.

BUTYL RUBBER. When isobutylene, which comes direct from the refinery gas stream, is co-polymerized with 2 to 3% of butadiene, Butyl rubber is obtained. The Butyl rubber process was shared before the war by Standard Oil with the I. G. Farbenindustrie, in accordance with the 1929 agreement. A plant making Butyl rubber has been in operation for some time at Bayway, Texas.

It is claimed that this process is more direct and superior to the Buna S technique. Not only must raw materials first be prepared for making Buna, but it is a batch process, necessitating the intermittent shutting down, cleaning out and recharging of polymerizing kettles. Butyl is therefore claimed to be simpler, using cheaper raw materials, and is formed in a continuous process. The untested performance of Butyl rubber is its present drawback. It is reported that a 10,000 mile experimental tire with 50% natural tire performance has been produced.

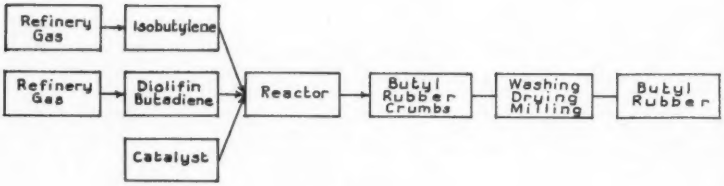
A number of Butyl rubber plants are under construction by the Standard Oil Company of Louisiana and Humble Oil and Refining Company. They were originally designed for a combined capacity of 60,000 tons per year, but with the adoption of new developments an increase to 192,000 tons per year was announced last summer, at an estimated increased cost of 27%. In order to save steel, one of the plants was eliminated. The remaining plants have a capacity of 132,000 tons a year.

Since Butyl rubber is 98 per cent isobutylene, increased capacity for this material will be necessary. Standard Oil and Humble are said to be able to supply 90,000 tons of isobutylene at no increased cost of construction materials. The 42,000 tons remaining will be supplied from other refineries building in the area under government auspices. Recent improvements in the Butyl rubber process are expected to reduce the plant investment by one-half, and reduce by five cents per pound the cost of manufacture.

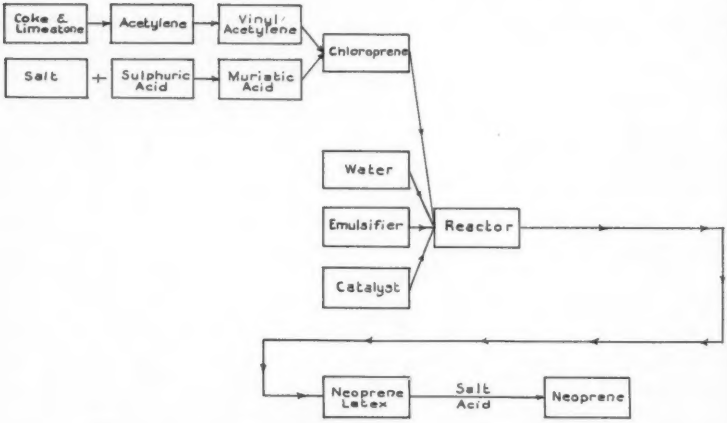
Two Revolutionary American Synthetic Rubbers.

NEOPRENE. A synthetic rubber produced on new lines was discovered by Father Julius Nieuwland, professor at Notre Dame University, assisted by Bolton, Carothers, Williams and Downing in the early 1920's. The butadiene to make this product was obtained from acetylene.

BUTYL RUBBER



NEOPRENE



The high price of crude rubber, due to the effects of the Stevenson Plan, became a matter of serious concern in the 1920's to rubber manufacturers the world over. Dr. Elmer R. Bolton, director of chemical research of the duPont Company, became convinced that butadiene was not the only derivative of acetylene that held commercial possibilities in the making of a rubber substitute. He heard Father Nieuwland read a paper in Rochester in December, 1925, on some unusual reactions of acetylene. A minor point raised by Nieuwland clicked in Bolton's mind. Under the leadership of Wallace Carothers, duPont developed chloroprene, closely resembling isoprene. As isoprene polymerizes to rubber, so chloroprene molecules linked together become Neoprene. It can be milled and processed generally like natural gum, but it is much more resistant to light and heat, oil and gas than is natural rubber and a number of

other chemicals. When heated it polymerizes or "vulcanizes" to a product resembling natural soft rubber.

These properties make Neoprene useful (sometimes preferable to rubber) for such products as hose, gaskets, packings; transition and conveyor belts; boots, soles and heels where an oil condition exists; tank linings where oil or high temperatures are encountered or both; soft roll cover, especially printers' rolls.

duPont brought Neoprene on the market in 1933 at $1.05 a pound, when crude rubber was selling for 2½ cents. It was bought by 80 different makers of rubber goods for those resistant qualities that rubber lacks. In 1934 the output doubled; it doubled again in 1935, and the price came down to 75 cents. The price is now around 65 cents. The latest production figures (December, 1941), were 6000 tons.

Recently Neoprene has been made available in semi-liquid condition, so that it may be used as a high solids' paint or as a troweling compound. This type of plasticized Neoprene may be of value for various corrosive conditions in the pulp and paper and other process industries.

One very important characteristic of Neoprene—a good product can be made which is light in color—even white. This is not true of some of the other synthetic rubbers.

NEOPRENE TIRES. Neoprene's comparatively high price has kept it out of commercial tires, but several years' road-testing has demonstrated that it is very satisfactory for treads. The Baruch Report strongly recommends it as the first supplemental tire in the Buna S program.

THIOKOL. Dr. J. C. Patrick upon his return from South America in 1922, where he had been serving the Armour packing interests, turned his attention to improving anti-freeze compounds. One day he mixed two readily available chemicals, ethylene dichloride and sodium tetrasulfide. When nothing happened he added a trace of acid. His test tube was clogged with an evil-smelling, gummy mass, rubbery to a marked degree. It could be sheeted out and milled like rubber; fillers could be incorporated. Its outstanding characteristics are a remarkable resistance to gasoline and lubricating oil—one of natural rubber's failings. Even now Thiokol remains in this respect the best of all synthetic rubbers. It lines the delivery hose of every gas pump. "Wiggin's" floating roof for gasoline tanks did not rest on a satisfactory cushion until Thiokol was tried. It emerged from this, its first test, triumphant, and this first cushion is still in active service.

Thiokol was an eye-opener to chemists. It is a long chain molecule. But its chemical composition is not even remotely similar to rubber, and the linking of molecules is accomplished by quite different means than in the polymerization of the hydrocarbons. Specifically, the Thiokol chain is formed of ethylene and sulphur; sodium chloride, common salt, drops out. The reaction

is called "condensation." It is similar to the formation of cellulose from sugars, by combining two of these and splitting out water to produce the ultimate cellulose unit. Patrick's discovery removed the emphasis in the hunt for a true artificial rubber similar chemically to natural rubber, and opened up a new field in the search for materials with rubber-like qualities.

By 1931 Thiokol had reached the commercial stage. A corporation was formed, and Dow Chemical was given orders for tons of sodium disulfide, ethylene dichloride, magnesium chloride and caustic soda. The caustic soda and chlorine are derived from salt; ethylene from petroleum or grain alcohol, and Texas supplies all the sulphur that is needed.

Dow has improved the process and varied the original formula to meet special needs. It is claimed that high alloy steels or scarce copper are not needed in manufacturing the required apparatus, as is the case with most synthetics, and that tanks for mixing, coagulating, washing and filtering can be made from any available material.

THIOKOL N. A tire has recently been made which is said to give a 10,000-mile performance. It is probably too early to know definitely whether a Thiokol tread can be made superior to one of commercial camelback. The value of the Thiokol tread was recognized in the following statement from the recent Baruch rubber report: ".....we recommend that sufficient reclaimed rubber, a small amount of crude, and an increased supply of Thiokol, or other substitutes, be made available for the tire replacement and recapping program, which we urge shall go into effect at once." The committee saw Thiokol as a pinch hitter in keeping "America on wheels" until the main synthetic program comes fully to hand. They recommended an expansion from 24,000, as previously planned, to 60,000 tons a year.

In retreading, the ribbon of Thiokol is firmly bonded to the rubber of the casing with the application only of heat and pressure, becoming an integral part of the tread without the use of an adhesive. Tires to be retreaded with reclaimed and natural rubber must be cemented to the buffed surface of the tires.

The government is using Thiokol in a score of ways which cannot be enumerated. It is the standard synthetic for non-swelling rubber in the presence of oil; Buna N comes second; then Neoprene; while natural rubber is tenth on the list. Thiokol recovers its shape after stretching as well as rubber does; it will not check, crack or crumble with aging and exposure to air and sunlight. Its resistance to abrasion is from one-half to the equal of rubber, under varying conditions. As a thermoplastic it can be ground up and molded again and again with the application of heat and pressure.

The First of the Plasticized Elastomers.

KOROSEAL. Out of experiments to perfect the rubber coating of metals came one of the earliest of a new chemical group of plastics possessing remark-

able rubber-like qualities. These elastomers are neither fish nor fowl; they are hybrids of elastomers and plastics.

Dr. Waldo Semon of the B. F. Goodrich Company began searching in 1935 for a rubber-like substitute material. He went back to isoprene, one of whose chemical names is 2 methyl divinyl. Various vinyl compounds had been found exhibiting plastic properties after polymerization. Limestone, plus coke plus salt equals vinyl chloride. Koroseal is made from acetylene with chlorine as the catalyst. Dr. Semon polymerized it into a polyvinyl, and after hundreds of trials plasticized it to give those rubber-like qualities he was then seeking.

Koroseal is conspicuously resistant to chemicals and oils. It cannot burn. Its versatility rivals natural rubber. By controlling the plasticization process it can be produced bone hard, jelly soft, or liquid. Although it cannot be vulcanized, it can be employed in almost all of the typical rubber and latex applications, such as in the manufacture of paper-thin, brightly colored transparent waterproof fabrics; raincoats, umbrellas, shower curtains, bridge table covers. The U. S. Army has recently tested this material for hospital rubber sheeting, and passed it with flying colors.

Some Other Promising Rubber Synthetics.

HYCAR O. R. This product is derived from butadiene and an unidentified ingredient. It is similar to Perbunan, but said to be more resistant to oil. Like Perbunan it will yield vulcanizates with a wide range of hardness. It is reported to give better wear value as a tire tread than natural rubber.

THE NEW-OLD ISOPRENE SYNTHETIC RUBBER. As part of the campaign to develop useful chemicals from turpentine, the Newport Industries, out of their experience with Sir William Tilden's isoprene, discovered a new product which promises to be tremendously valuable in high flying planes. It remains soft and rubber-like at temperatures so low that other synthetics are "frozen" stiff and brittle. By getting better polymerization of this true synthetic rubber molecule, they improved the tensile strength and resistance to abrasion, qualities that had been notably poor in isoprene polymers. At the same time they retained isoprene's characteristics to withstand low temperatures. And this new product will help other synthetics in this respect.

It is reported their new pilot plant with an output of 1,000,000 pounds a year will be in production sometime during the fall of 1942. It won't help much in relieving the rubber famine, because turpentine is in limited supply; it is needed for other important uses, and is comparatively high priced.

During the past decade many rubber-like plastics have appeared; of quite different chemical composition from natural gum, some made from vinyl compounds, such as Flamenol (General Electric, primarily to coat wires and cables); Resistoflex (so flexible it can be tied in knots, used for tubing, brake linings, even gloves); and others from butane compounds, and even derivatives

Physical Properties of Synthetic and Natural Rubbers.

Material	Tensile Strength lbs. sq. in.	Hardness Shore Durometer	Effect of Heat	Abrasion Resistance	Effect of Sunlight	Effect of Aging	Machining Qualities
Buna S	3,800	15-90	Stiffens	Equal Rubber	Slight	Equal rubber	Can be ground
Butyl Rubber	500-3000	15-90	Softens slightly	Good	None	Better than rubber	Can be ground
Chemigum (oil resistant)	800-4000	30-90	Stiffens	Excellent	Equal to rubber	Stiffens	Can be ground
Chemigum (tire)	1000-4000	50-65	Stiffens	Excellent	Deteriorates	None	.....
Hycar, OR, or OS (hard)	4000-11,000	.....	Stiffens at 300 F.	Good	Very slight	None	Excellent
Hycar, OR (soft)	1000-4500	15-95	Stiffens slightly	Excellent	Slight	Highly resistant	Can be ground
Hycar, OS (soft)	1000-4000	20-95	Stiffens slightly	Excellent	Slight	Highly resistant	Can be ground
Koroseal (hard)	2000-9000	80-100	Softens	Good	None	None	Good
Koroseal (soft)	500-2500	30-80	Softens	Good	None	None	Can be ground
Neoprene	1000-4500	10-95	Stiffens slightly	Excellent	None	Highly resistant	Can be ground
Perbunan	500-5000	30-90	Stiffens	Excellent	Slight	Highly resistant	Can be ground
Pliolite No. 40	4000-5000	.....	Softens	.....	None	None	.....
Resistoflex	2000-5000	.....	Softens	Good	None	None	.....
Thiokol FA	1400	25-90	Hardens slightly	Fairly good	None	None	Excellent
Tygon T	9000	.....	Softens	Good	None	.....	Excellent
Vistanex (medium)	200	.....	.....	.....	None	Better than rubber	Cannot be machined
Vistanex (high)	550	.....	.....	.....	None	Better than rubber	Cannot be machined
Natural Rubber (hard)	4000-11,000	70-100	Softens	Good	Discolors	None	Excellent
Natural Rubber (soft)	1000-6000	30-80	Softens and det.	Excellent	Deteriorates	Highly resistant	Can be ground

International.

These long sheets of synthetic rubber are being inspected at one of the plants of the Standard Oil Company of New Jersey, preparatory to its being sliced into sheets for packing and shipping to plants where it will be processed, just as natural rubber is handled.

from natural rubber. Of the last named Goodyear's Pliofilm is typical (a rubber hydrochloride, used in making transparent raincoats and umbrellas).

All these plastic elastomers lack the stretch of natural rubber, but have great flexibility and waterproof qualities. Rationed rubber will stimulate the growth of all these products, and while not produced in quantities that seem impressive, they will do their bit in saving just so much rubber or synthetic rubber.

Hazards of Synthetic Rubber Processes.

There is very little fire and explosion experience on record regarding these hazards in the synthetic rubber processes. Information from foreign sources is meager. There is no mention in any of the German publications surveyed up to December, 1941, as to the extent to which German production has been impeded by fires and explosions.

Every experienced chemist, however, knows that the hydrocarbons in a normally safe process can be exploded should elements not intended to come into contact with them combine with them through some negligence or mistake in human conduct. It is therefore probably impossible to devise precautions which will totally eliminate these hazards. But it is absolutely necessary that every precaution be exercised to keep these hazards at a minimum, not only

to avoid an appalling loss of life and property, but to get every possible ounce out of production.

All these synthetic processes utilize flammable liquids or gases, which are explosive when mixed with air. In the case of some of the materials, there is at least a theoretical possibility that the material may have the additional hazard of chemical reactions of almost explosive violence. To translate this hazard into familiar terms, it appears clear that the hazard will be greater than that of processes involving gasoline and similar flammable liquids. Butadiene's boiling point is 26° F.; the lower explosive limit is about 2%. The closed cup flash point of styrene is about 90° F.; the lower explosive limit is 1 to 1½%.

Oil refineries are subject to occasional fires and explosions, but the oil industry, as a result of experience over the years, has established proper safeguards, through competent design of equipment and provision for proper fire protection facilities, so that fires have been kept within reasonable limits. Likewise the duPont Company with their more than a century background in the manufacture of explosives have developed a knowledge and successful practice in controlling the explosion and fire hazards of their business second to none in the United States. During the decade in which they have been making Neoprene they have had very few explosions and fires in the plant devoted to its production.

The particular feature of concern in connection with the synthetic rubber processes is that the entire development of this industry is proceeding on an enormous scale, and at great speed in the erection of new plants, which plants will of necessity have to be staffed with an operating personnel with very limited, if any, previous experience.

The petroleum, rubber and explosive powder industries in developing new processes have been accustomed to a gradual evolution from relatively small to large scale plants. Under these conditions the operating hazards have had time to be evaluated and suitable safeguards instituted through some years of experience.

No such opportunity exists today in the synthetic rubber program. Furthermore, the demand for speed and the shortage of critical materials seems very likely to result in short cut methods which will give very little consideration to such safeguards as might be provided for new processes in normal times.

These considerations all point to the definite conclusion that the entire synthetic rubber industry is faced with a very serious fire and explosion hazard with the probability of large losses causing serious interference with production.

Since the major tonnage of the U. S. program is in Buna S rubbers, the following information given to the American Chemical Society by D. A. Scott of the Shell Development Company, Emeryville, California, and published in the A. C. S.'s News edition of May 10, 1940, may be helpful:

"Butadiene, when heated under pressure, may undergo violent thermal decomposition. In one instance, explosive decomposition with carbon formation occurred on heating butadiene in a stainless steel bomb, while previous similar experiments gave no unexpected occurrences. Perhaps enough material was placed in the bomb so that it became entirely filled with liquid on heating, and the hydrostatic pressure may have initiated a decomposition similar to that taking place in acetylene upon compression. No explosions resulting from heating at atmospheric pressure have been observed in the absence of oxygen.

"In contact with air or oxygen, butadiene may form violently explosive peroxides and may be detonated by either mild heating or mechanical shock.

"Solid butadiene, exposed for a very short time to oxygen at subatmospheric pressure, absorbed sufficient oxygen so that on warming slightly above the melting point a violent detonation occurred. It is suspected that this behavior of butadiene is influenced strongly by the accidental presence of oxidation catalysts or inhibitors. Addition of an inhibitor to butadiene which is to be distilled or allowed to stand in contact with air or oxygen, even at low temperatures would help avoid explosions.

"After emptying a storage tank of crude butadiene some polymer was found at the bottom. The polymer contained 0.095 equivalent of peroxide of oxygen per 100 grams and could be detonated easily by a hammer blow. The polymer containing the oxygen compounds was insoluble in the butadiene, and the butadiene itself showed only a trace of peroxides. The peroxides were probably formed by reaction between butadiene and air. Subsequent investigation showed the peroxides could be destroyed safely by treatment with strong caustic soda (48 deg. Bé; 47% sodium hydroxide)."

It is also known that the co-polymerization of butadiene and styrene or acrylonitrile produces heat in the same way as heat is produced in the polymerization of the vinyl compounds. Therefore the reactions must be carefully controlled, the reaction vessels being adequately protected with emergency vents. The experience of those companies manufacturing vinyl plastics is generally applicable to the manufacture of synthetic rubber of the Buna types.

In protective measures, foam is applicable only to styrene storage and handling. The protection of butadiene storage tanks and processing equipment is best obtained by piped spray nozzle systems for fire protection. Fires of escaping butadiene are not being extinguished until the flow of butadiene can be stopped. Accordingly it is necessary to protect equipment against damage from fires by the cooling action of water applied in spray form. Where small fires are involved, approved dry compound gas pressure type of fire extinguishers are suitable as first aid equipment, as are portable water spray nozzles for use on fire hose.

The U. S. Synthetic Rubber Production Program.

The four rubber companies—Firestone, Goodrich, Goodyear and U. S. Rubber—are producing Buna S elastomers by combining (polymerizing) the butadiene and styrene, which are supplied to them by the petroleum companies, and fabricating the resulting product into tires.

The table shown below gives the scheduled production tonnage and dates when the various processes are to be completed, month by month:

Synthetic Rubber Time Table.

Butadiene Plants.

	Capacity Tons	Completion Date
Carbide & Carbon	5,000	Sept. 1942
Standard Oil (La.)	6,200	Sept. 1942
Atlas Oil & Refining	12,000	Nov. 1942
Carbide & Carbon	20,000	Jan. 1943
So. California Gas	25,000	Jan. 1943
Carbide & Carbon	20,000	Feb. 1943
Carbide & Carbon	20,000	Mar. 1943
Humble Oil	30,000	Mar. 1943
Shell Oil	30,000	Mar. 1943
Standard Oil (La.)	15,000	Mar. 1943
Carbide & Carbon	20,000	Apr. 1943
Carbide & Carbon	20,000	Apr. 1943
Neches Butane	50,000	Apr. 1943
Carbide & Carbon	20,000	May 1943
Carbide & Carbon	20,000	May 1943
Carbide & Carbon	20,000	June 1943
Carbide & Carbon	20,000	June 1943
Neches Butane	50,000	June 1943
Rubber Synthetics	50,000	June 1943
Carbide & Carbon	20,000	July 1943
Cities Service	55,000	Aug. 1943
Koppers United	20,000	Aug. 1943
Rubber Synthetics*	50,000	Aug. 1943
Sinclair Rubber	50,000	Oct. 1943
	648,200	

*Abandoned the project. Tonnage allotted to the other companies.

NOTE: The above total tonnage figures were raised to slightly over 800,000 in mid-September with the provision for enlarged plant capacity.

Styrene Plants.

	Capacity Tons	Completion Date
Monsanto	10,000	Oct. 1942
Carbide & Carbon	12,500	Jan. 1943
Dow Chemical	4,200	Jan. 1943
Monsanto	10,000	Jan. 1943
Monsanto	10,000	Feb. 1943
Dow Chemical	25,000	Mar. 1943
Monsanto	5,000	Mar. 1943
Carbide & Carbon	12,500	Apr. 1943
Dow Chemical	25,000	Apr. 1943
Dow Chemical	25,000	June 1943
Dow Chemical	25,000	June 1943
Dow Chemical	12,500	Aug. 1943
Koppers United	35,000	Aug. 1943
	211,700	

NOTE: In mid-September provision was made for enlargement of plants.

Co-polymer Plants.

Goodyear	15,000	May 1942
Firestone	15,000	June 1942
Goodyear	15,000	Aug. 1942
U. S. Rubber	15,000	Aug. 1942
Firestone	15,000	Sept. 1942
Goodrich	30,000	Nov. 1942
U. S. Rubber	15,000	Nov. 1942
Goodrich	30,000	Jan. 1943
U. S. Rubber	30,000	Jan. 1943
Firestone	30,000	Feb. 1943
U. S. Rubber	30,000	Mar. 1943
Goodrich	30,000	Apr. 1943
Goodyear	30,000	Apr. 1943
Goodrich	15,000	May 1943
Goodyear	15,000	May 1943
U. S. Rubber	30,000	May 1943
Firestone	15,000	June 1943
Goodrich	10,000	June 1943
Goodyear	30,000	June 1943
Goodyear	10,000	June 1943
U. S. Rubber	15,000	June 1943
Open	30,000	June 1943
Open	30,000	June 1943
Firestone	15,000	July 1943
U. S. Rubber	15,000	July 1943
Firestone	15,000	Aug. 1943
Firestone	60,000	Aug. 1943
U. S. Rubber	15,000	Aug. 1943
Open	25,000	Aug. 1943
Goodyear	55,000	Oct. 1943
	700,000	

Butyl Plants.

	Capacity Tons	Completion Date
Standard Oil (La.)	7,000	Nov. 1942
Humble Oil	20,000	July 1943
Standard Oil (La.)	30,000	July 1943
	57,000	

Neoprene Plants.

duPont	10,000	Oct. 1942
duPont	10,000	Apr. 1943
duPont	20,000	Oct. 1943
	40,000	

As the program now stands it has been expanded to 1,100,000 tons of completed products. Of course all of this production will not be completed until sometime in 1944. By mid 1943 the butadiene schedule calls for at least 450,000 tons annually, with 500,000 of co-polymer capacity to be ready at that time. The Baruch Report recommended the construction of plants to produce 100,000,000 gallons of grain alcohol located near the sources of grain pro-

ducing areas, and accessible to water transportation. This would make it possible for molasses to be brought to the plants by barges after the war in the event that the manufacture of alcohol from grain proves uneconomical.

The analysis of the rubber situation made in the Baruch Report disclosed the Committee's concern over the then scheduled production figures with their slight margin of safety to meet the military and essential civilian needs in 1943 should plant construction not click on schedule.

The Committee saw Buna S and Neoprene as the only synthetics with sufficient performance background "to be used for combat and heavy duty tires." They believed these two synthetics and a portion of the Butyl rubber could offset the likely deficit of crude rubber which the country faces in 1943. By stepping up production to the present schedules we have made doubly sure that our scheduled Buna S production will not fall below 200,000 tons in 1943 due to any inability in the meantime to obtain sufficient critical material for our expanded plant program, in which predicament we would not have sufficient Buna S to supply our expanding military needs.

The production of Buna S and Neoprene (the two synthetic materials on which we now rely most to replace crude rubber) is scheduled to produce 425,000 tons by the end of 1943. In meeting this schedule we should have a margin of safety, perhaps 100,000 tons, above necessary inventories for ourselves and our allies—for the Front.

The future of the rubber supply after the war is uncertain, but many informed oil and rubber chemists believe that synthetic rubber production in this country will continue on a large scale despite competition from natural rubber. Their convictions would seem to be justified when considering the position some of our synthetics had attained before the war. Even though a comparable synthetic tire may not be produced which will be equal to or better than natural rubber at equivalent or lower costs, the synthetic industry is certain to have expanding possibilities.

Silver Company Fire, Taunton, Mass.

The neglect of well-known fundamentals of fire protection and fire prevention resulted in the destruction of industrial buildings occupied by the National Silver Company and the F. B. Rogers Company at Taunton, Massachusetts, on September 12, 1942. About 50 per cent of the production was said to have been war work, including the manufacture of bomb noses. The loss was estimated at approximately $275,000 by the fire department. Failure to segregate obvious fire hazards, coupled with a closed post indicator valve controlling the automatic sprinkler system, permitted the fire to gain such headway that effective control by manual means was impossible.

Description of Plant.

The plant had originally been erected for cotton mill occupancy. The main building consisted of two major sections, a one-story and basement "weave shed" and the adjoining four-story "main mill." In addition, there was an attached engine room section and a detached office building. The buildings had brick walls with plank and timber floor and roof construction. Unprotected window openings on the upper floors of the main mill directly overlooked the sawtooth roof of the weave shed section. The weave shed covered an area of 150 by 101 feet, while the main mill was 150 by 64 feet in area. The plant was protected by an overloaded dry pipe sprinkler system supplied by 12-inch city mains through an 8-inch yard system. There was a sprinkler alarm connection to the fire department central station.

Since 1939 the plant had been occupied by the two allied plants normally making silver plated and pewter ware and novelties. Recently the plant had been doing considerable war production, consisting chiefly of work on small parts, carried on in the plant's tool room. The plant was working on two shifts, with the second shift normally working until 11 P.M.

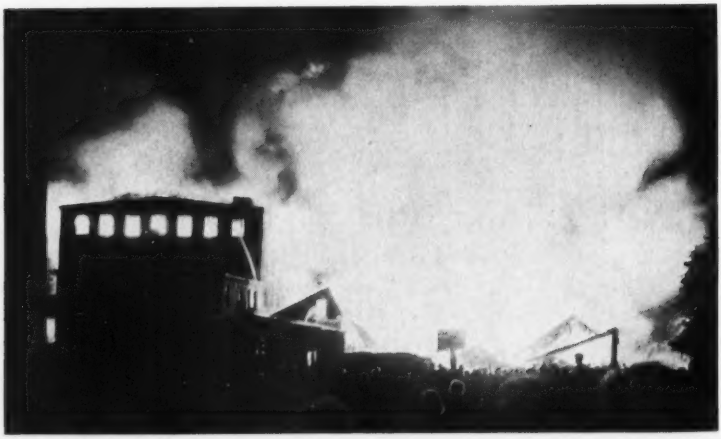
Story of the Fire.

On the night of the fire a few men were doing spot welding in the basement of the weave shed near the lacquer dipping department. About 11:30 P.M. a spark from the welding machine apparently dropped into pyroxylin scrap on the floor and the resultant flash fire ignited lacquer in open tanks in the near-by lacquer dipping department which was not cut off from the welding area. The pyroxylin material had been used on the plant's regular line of products. The lack of cut-off arrangements for the lacquer dipping department and the proximity of the lacquer dipping department had been previously

NOTE: This account is based upon reports by Eastern Underwriters Inspection Bureau (Member N.F.P.A.), Fire Chief Edward F. Gorey of the Taunton Fire Department, and other sources.

Robert G. Sears.

Fire on September 12 started in the basement of the building shown above, when a welding spark dropped into pyroxylin scrap on the floor destroyed the plant of the National Silver Company and the F. B. Rogers Company at Taunton, Mass. This plant was working in part on war contracts.



Robert G. Sears.

Fire started in the building shown as blazing ruins at the right and spread through unprotected window openings into the four-story main mill at the left.

Robert G. Sears.

When the fire chief arrived at this fire he found the post indicator valve controlling the sprinkler system shut off. This closed valve also prevented the operation of the waterflow alarm to the fire department. While information has not been made available to indicate whether the valve was shut due to carelessness or sabotage, this blaze emphasizes the responsibility of plant management to make certain that sprinkler valves are kept open.

criticized by fire insurance inspectors, but no attention had been paid to recommended improvements by the plant officials.

At the time the alarm was received, Fire Chief Edward F. Gorey happened to be near the plant. He reports that when he arrived flames were coming out of the windows on both floors of the weave shed building. At that time he found the post indicator valve, which was the sole sprinkler control for the plant, shut off. There is no indication in any available report as to who shut off the sprinklers or why they were shut off. The Chief had the valve opened, but because of the large number of sprinkler heads which had already fused it was subsequently found necessary to again close the valve in order to conserve water for hose streams.

It appears that there was some delay in calling the department. The first alarm was received by telephone. It is reported that some time was lost because the telephone was located in the plant office building, which was locked for the night. The sprinkler waterflow alarm to the fire department and the sprinkler alarm gong on the plant were both inoperative due to the closed sprinkler valve.

With sprinklers turned off, the fire in the mill structures was beyond control from the time the first firemen arrived. Some fifteen hose streams were used in protecting exposed property, including a number of dwellings.

The fire very quickly entered the unprotected window openings on the third floor of the main mill and quickly spread throughout the structure. Much of the work of the fire department was devoted to the protection of near-by exposures and to the patrolling of other industrial plants endangered by flying brands. The fire was fought by six engine and three ladder companies. Fifteen hose streams including several deluge sets were used.

The loss to buildings was estimated at $75,000, and the loss to contents at about $200,000. Fortunately, some of the machines used in the manufacture of war equipment were salvaged and moved to another location.

W. F. Shrigley.

Almost any fire which destroys or damages a manufacturing plant may be said in some measure to impede conversion of our industrial facilities to all-out war production. A case to the point was the above fire which destroyed the Ohio Casket Hardware Division of the Allen Tool and Die Manufacturing Company plant at Springfield, Ohio, last July 17. This plant was preparing for conversion to war production work, but was finishing casket hardware at the time the fire occurred. The plant officials are quoted as stating that they had had considerable difficulty with children playing in the alleyway at the rear of the plant. A vent duct from paint spray booths terminated near the ground level in this alleyway. The fire was first discovered in the paint spray booth, and it is believed that a small fire started by the children may have entered the ducts.

Cork Storage Fire, Kearny, N. J.

Report by Factory Insurance Association,
(Member N.F.P.A.)

Two million pounds of cork were involved in a fire on August 3, 1942, which burned for several days after a tank truck, loaded with flammable cleaning solvent, crashed into the storage building and exploded. The driver of the truck was burned to death and property damage has been tentatively estimated at $100,000.

Construction and Occupancy.

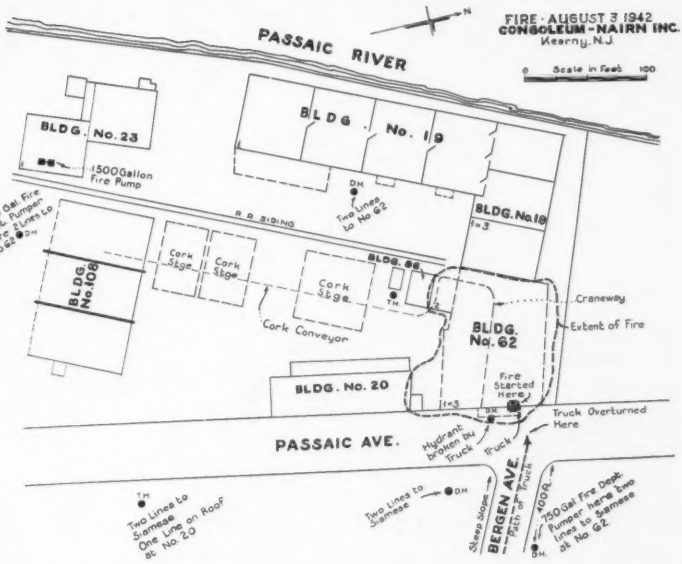
The storage shed, known as Building No. 62, is a unit of the linoleum plant of Congoleum-Nairn, Inc. It is a single-story structure of regular shape, roughly 84 feet by 99 feet, with an eave height of about 40 feet. The roof is of corrugated iron on steel truss construction. The south, east and north sides are open except for corrugated iron curtain walls on the north and east sides, which are about 25 feet in height from the ground. Building No. 62 is separated on the west side from Building No. 19 by a sub-standard fire wall. It is not equipped with sprinklers, but hydrant protection and water supplies, both public and private, are considered good except for a lack of hydrants on the north side. A well-organized private fire brigade is maintained.

The contents of the building consisted of about 1000 tons of baled imported and domestic scrap cork and bagged ground cork waste. The bagged ground cork was placed on top of the pile of baled cork and was packed tightly together, occupying the full area of the building to a height of approximately 40 feet.

The improvement of storage conditions had been the object of considerable attention by the management and underwriters for some time. Improvements had been carried out in other storage units and progress was being made until the war resulted in the "freezing" of the cork stock by the War Production Board and hampered the procurement of steel and fire protection equipment. Unfortunately, the demands on cork storage space had been so great that in spite of having constructed and placed in use a new sprinklered storage building, the management had only partially reduced the height of the storage in Building No. 62 and had not provided the aisle spaces and water curtains which had been recommended.

Story of the Fire.

Shortly after 5:00 P.M. on August 3, a semi-trailer tank truck containing some 2000 gallons of flammable solvent went out of control while coming down a steep hill, "jack-knifed" and crashed into the wire fence which surrounds the plant near the center of the east wall of Building No. 62. The trailer exploded almost instantly, throwing the burning solvent onto the cork,



which ignited immediately. The intense heat thwarted attempts by passing motorists to rescue the driver, who was trapped in the cab of the truck.

An alarm was transmitted to the Kearny Fire Department through a manual A.D.T. box and the pulling of the A.D.T. box sounded the alarm for the plant fire brigade. The brigade went into action at once and laid eight hose lines from near-by hydrants, and the 1500 g.p.m. pump was started immediately. The Kearny Fire Department responded promptly with equipment consisting of a ladder truck, a 1500 g.p.m. pumper and a 750 g.p.m. pumper, sounding a second alarm immediately upon arrival. Auxiliary firemen from both the Kearny and Harrison Defense Councils responded and assisted the public department. About 100 plant employees also helped in manning hose lines and in moving exposed materials.

Ten or twelve hose streams were used to confine the fire to Building No. 62 and to the great credit of the fire fighters it was brought under control promptly, although it continued to burn for several days. The public department left the scene on August 5, but the plant brigade continued with the work of tearing down the piles of cork and extinguishing the scattered fires.

The principal damage, was, of course, to the cork storage, and just how successful were salvage operations is not known. The steel truss members of Building No. 62 were somewhat warped and the roof and curtain walls were badly damaged. A crane and craneway in the building were also damaged.

Newark Evening News.

Firemen are shown directing hose streams on the east wall of Building No. 62. The overturned tank truck which caused the fire is clearly visible in the background.

There was likewise minor damage to Building No. 96 (cork grinding) and Building No. 20 (garage). It is anticipated that building repairs will be considerably delayed because of the present regulations applying to steel.

Conclusions.

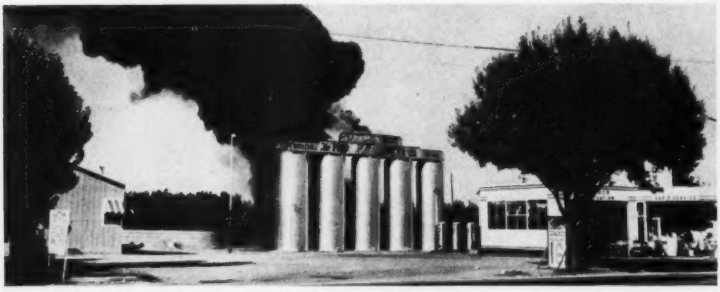
Although the direct cause of this fire is not one which would ordinarily be anticipated, it cannot be said that the conflagration teaches any new lessons. In view of the conditions of storage it is only to be wondered that the fire fighters were successful in confining the fire to the building of origin. The measures necessary to adequately safeguard quantities of cork from the ravages of fire are well known. It is to be regretted, however, in view of the critical shortage of cork and in spite of the very definite object lesson afforded by the fire at the Crown Cork & Seal Company in Baltimore (see October, 1940, QUARTERLY, p. 136) that more progress had not been made in eliminating all of the hazardous conditions which existed in Building No. 62.

Glen Perrins, Ogden Standard-Examiner.

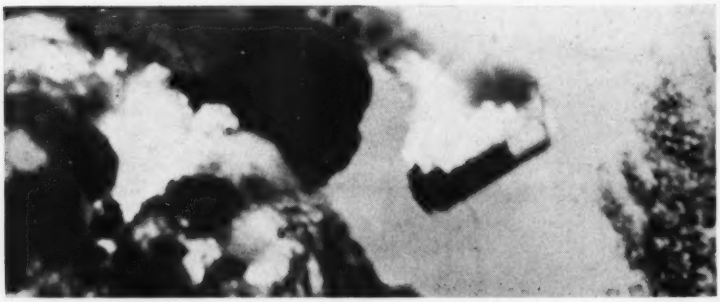
This large oil and grease warehouse in Ogden, Utah, was razed by fire of unknown origin on July 28. Exploding gasoline storage tanks fed the flames. Almost the entire structure was in flames before the fire department was able to place a single stream in operation. There was no delay in calling the department, but the building was of large-area frame-stucco construction, there were no fire walls or fire doors, and hydrants were somewhat widely spaced in the section where the fire occurred. Figures as to the exact extent of the loss have not yet been reported.

Marysville Oil Tank Fire.

The following series of photographs of a fire which occurred at Marysville, California, on July 18 and 19, 1942, sent us by Chief Engineer Loren S. Bush of the Board of Fire Underwriters of the Pacific (Member N.F.P.A.), present an unusually graphic object lesson as to the hazards of this class of property.



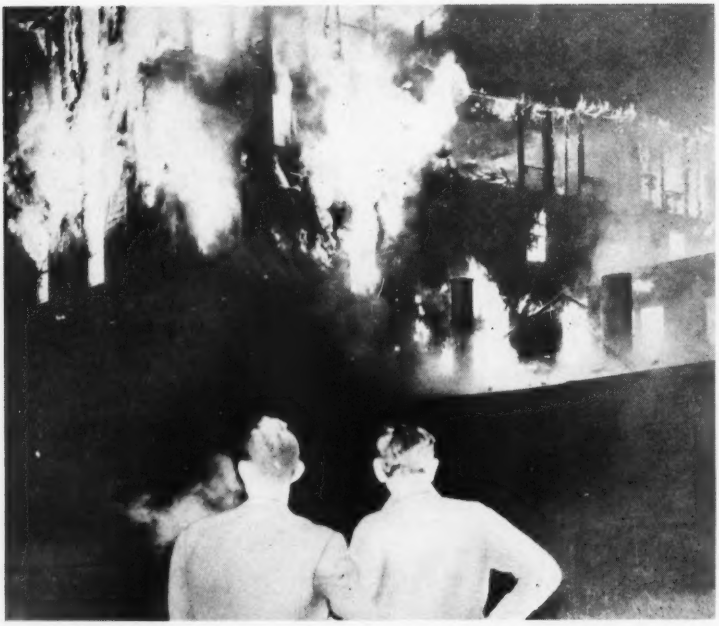
Tank trucks were loaded and unloaded at a wooden platform behind the tanks shown in this picture. Under the platform were pumps operated by ordinary electric motors. Gasoline fumes were ignited by a motor and fire flashed the length of the platform, feeding on spilled oil and trash. The truck driver drove the truck away safely. A fire alarm was promptly sounded, but owing to the delay due to another fire, it was fifteen minutes before the first fire truck arrived.



The tanks lacked adequate vents to relieve internal pressure as specified by the N.F.P.A. Flammable Liquids Ordinance. One gasoline and one kerosene tank had already exploded before the firemen arrived. At the moment the firemen arrived another gasoline tank exploded, going so high in the air that the men had time to jump into the truck and drive it out of danger before the tank hit the ground four feet from where the truck stood. This picture shows the tank on its way down.

The wreckage of the tank where it fell on the highway. The bulged end shows the deformation characteristic of high internal pressure.

The fire spread to a warehouse containing some $50,000 worth of oils and greases, etc. The warehouse was a total loss, but the firemen were successful in preventing spread of fire to the furniture exchange building seen at the left of this picture. The total loss from this fire is estimated at $72,400, including $2000 damage to an adjacent orchard where many trees were killed by the terrific heat, and $400 to electric power lines. There was no water system available for fire fighting, but two fire trucks provided a total of 1350 gallons of water.



Tannery Fire, Norwood, Mass.

Except for fine work by the fire department a much larger loss would have resulted from this fire, which destroyed a large unit of the Winslow Brothers and Smith Tannery at Norwood. The fire, accompanied by several severe explosions, originated the night of August 24 on the top floor of a four-story, large-area frame factory said to be engaged in the filling of war contracts. Considerable delay in sending in the alarm was occasioned when employees who discovered the fire fought the blaze with chemical extinguishers. One workman lost his life on the upper floor of the building when trapped by the rapid spread of the flames, which had completely involved the three top floors when the fire department arrived. The three companies responding to the first alarm had a total man-power of six paid men, so that there was some delay in getting the hose streams into operation until call firemen arrived. While only one alarm was sounded for the fire, help was called from near-by communities. No heavy stream appliances were used in fighting the fire, which was controlled by the use of some 15 hand lines. It was discovered that the sprinkler valve in the burning building had been closed by the watchman the previous night due to low air pressure on the dry pipe system. There was no necessity for closing the valve, as the system could have been left wet until the dry pipe valve could have been reset. The loss was estimated at $325,000, but it is reported that except for effective fire fighting a loss of two or three million dollars might easily have resulted.

Fires and Fire Losses Classified, 1941.

Continuing the practice begun five years ago of showing the distribution of the annual fire loss in the United States by cause and occupancy classes, the N.F.P.A. Department of Fire Record presents the following tables covering the year 1941. Experience of the past years shows that these estimates are widely used in fire prevention and fire protection work.

The data upon which these tables are based were obtained from thirteen state fire marshals' reports for the year 1941, or the closest fiscal year thereto. Reports of these particular states were chosen because they contained the most complete classifications. While methods of reporting and tabulating the fire loss figures are different in each state, it is believed that the volume of statistics from the thirteen typical states included herein is sufficiently large to indicate the relative distribution of fires and fire losses for the various occupancies and causes.

Tables I to IV are tabulations from fire marshal's reports. Table I shows the number of fires, and Table II shows the fire loss by occupancies reported for the year 1941 in the thirteen states. Tables III and IV show the number of fires and losses distributed according to causes. The general classes making up both the occupancy and cause classifications were carefully chosen with regard to good practice and to classes most commonly used in the reports. Tables V to VII are recapitulations and estimates for the entire United States based upon the first four tables and adding a certain percentage to cover unreported fires and losses as explained below.

Table V is a recapitulation of the state totals presented in the foregoing tables, with columns added to show the number of fires per thousand population and the fire loss per capita. It will be observed that a total of 92,053 fires were reported in 1941 for the group of thirteen states having a total population of 32,877,555 in the 1940 census. A study of the best data available indicates that this number of fires is approximately half the actual number of fires for the year, and therefore 100 per cent has been added to get the estimate for the thirteen states. When the resulting figure is applied to the whole country at the population ratio, the estimated number of fires in the United States in 1941 is 736,000. This makes 5.58 fires per thousand population, as compared with 5.50 in 1940 (October, 1941, QUARTERLY, page 177).

The estimated fire loss of $325,000,000 in the United States in 1941 was obtained by applying the population ratio to the total loss in the thirteen states and adding 30 per cent to cover unreported losses. This figure is $35,000,000 more than 1940 and $45,000,000 more than 1939.

Table I. Number of Fires by Occupancies in Thirteen States — 1941.

Occupancy	Connecticut	Illinois	Indiana‡	Iowa	Kansas	Massachusetts	Nebraska	Ohio	Oregon*	South Dakota†	Vermont	West Virginia	Wisconsin	Total
I. Public Buildings														
Government buildings	1	9	4	3	....	29	....	....	17	1	3	....	12	79
Hospitals, institutions	2	11	4	2	5	8	....	36	....	1	6	....	32	107
Schools	26	52	1	27	12	35	6	43	23	10	13	7	101	356
Churches	12	69	6	21	12	27	8	102	17	4	11	4	54	347
Theatres	5	27	4	14	6	9	8	48	17	5	....	2	26	171
Amusements, halls	18	38	7	13	....	60	8	95	....	4	3	....	72	318
II. Dwelling Occupancies														
Hotels, boarding houses	23	244	5	27	15	80	12	164	457	28*h*	27	1	155	1,238
Apartments, rooming houses	98	2,895	11	143	....	....	10	1,976	....	....	1	6	225	5,365
Dwellings	1,010	5,201	584	2,078	1,031*a*	3,990	709	11,977	5,444	398	1,328	283	11,298	45,331
III. Mercantiles														
Office bldgs., including banks	20	130	24	32	....	87	13	145	....	10	....	4	61	526
Restaurants, taverns	53	378	11	72	....	116	26	....	100	....	12	4	376	1,148
Barber, beauty shops	....	27	....	7	....	12	6	....	....	....	2	....	20	74
Misc. mercantiles	229	1,039	32	232	357*b*	690	93	1,367	613*b*	69	187	26	779	5,713
Warehouses	37	63	12	57	3	153	13	315	7	....	....	9	92	761
IV. Manufacturing														
Metal workers	2	41	....	17	1	20	....	....	40	5	2	....	37	165
Woodworkers	....	3	....	4	....	15	....	....	....	1	29	1	7	60
Flour mills, elevators	....	68	1	36	9	....	11	....	9	7	2	....	46	189
Packing plants, stockyards	1	....	1	....	....	2	....	....	....	2	....	1	5	12
Bakeries	11	25	3	8	....	8	....	....	....	....	2	1	14	72
Laundries	8	44	1	10	13*c*	17	....	60	....	3	1	1	18	176
Cleaners, tailors	....	35	5	7	....	20	....	30	....	2	2	....	18	119
Misc. manufacturing	113	412	25	49	8	411	43	1,156	189	13	35	8	320	2,782
V. Miscellaneous														
Barns	104	426	31	195	301*d*	203	....	637	367*g*	102*g*	749*d*	....	550	3,665
Outbuildings	96	940	40	168	....	169	186	657	....	1	14	37	279	2,587
Lumber yards	....	16	4	4	3	15	10	74	79	2	....	1	10	218
Railroads, wharves	4	12	10	17	....	17	....	....	....	4	2	1	5	72
Bulk oil storage, refineries	12	43	....	2	33*e*	....	....	....	28	3	....	....	....	121
Garages, filling stations	154	1,073	63	213	10*f*	340	110	1,809	31	61	29	13	385	4,291
Power plants, pump houses	....	11	2	10	8	3	....	....	26	3	7	....	40	110
Creameries, dairies	....	....	1	7	5	....	....	....	....	5	....	....	15	33
Miscellaneous structures	4	422	17	108	21	75	77	1,842	....	....	....	1	69	2,636
Motor vehicles, inc. aircraft	177	2,518	76	431	196	458	143	3,780	837	104	....	99	2,143	10,962
Fires other than structures	30	410	30	71	....	12	....	340	....	28	4	2	1,314	2,241

•Number of insurance claims, not number of fires.
†Fiscal year ending June 30, 1942.
‡Fiscal year ending June 30, 1941.
a. Does not include farm property.
b. Includes office buildings.
c. Includes cleaners.
d. Includes all farm property.
e. Includes filling stations.
f. Includes airplane hangars.
g. Includes outbuildings.
h. Includes restaurants.

‡Fiscal year ending June 30, 1941.
a. Does not include farm property.

d. Includes all farm property.
e. Includes filling stations.

h. Includes restaurants.

Table II. Fire Loss by Occupancies in Thirteen States — 1941.

Occupancy	Connecticut	Illinois	Indiana‡	Iowa	Kansas	Massachusetts	Nebraska	Ohio	Oregon*	South Dakota†	Vermont	West Virginia	Wisconsin	Total
I. Public Buildings														
Government buildings	$150	$12,366	$1,930	$1,355	....	$7,782	....	....	$846	$75	$4,171	....	$10,625	$39,300
Hospitals, institutions	25	167,037	745	45	$8,610	20,924	....	$13,396	....	205	16,206	....	20,510	247,703
Schools	111,956	467,078	2,200	171,256	110,671	163,767	$1,845	186,390	9,125	97,156	75,610	$91,850	125,482	1,614,386
Churches	407,251	146,965	45,020	84,382	13,165	327,437	17,460	114,784	22,432	11,850	13,399	11,650	32,636	1,248,431
Theatres	4,524	51,475	2,662	123,479	8,687	118,259	12,840	19,480	9,172	1,954	....	10,800	6,667	369,999
Amusements, halls	73,769	80,669	1,260	12,582	....	249,617	12,274	73,285	....	5,375	120	....	62,205	571,156
II. Dwelling Occupancies														
Hotels, boarding houses	28,259	155,029	235	24,530	17,995	110,743	6,174	59,494	80,755	15,162*h*	26,626	15,000	21,569	561,571
Apartments, rooming houses	58,031	133,973	9,945	118,738	....	....	18,909	360,455	....	....	37	16,755	43,253	760,096
Dwellings	1,150,266	2,583,536	273,342	1,241,070	294,317*a*	4,698,358	419,160	3,271,426	900,166	111,806	282,822	473,178	1,847,809	17,547,256
III. Mercantiles														
Office bldgs., including banks	37,816	120,304	41,976	60,190	....	946,682	2,566	29,956	....	1,052	....	6,310	9,255	1,256,107
Restaurants, taverns	733,961	334,240	6,119	62,777	....	263,986	34,265	....	21,604	....	12,587	28,650	147,609	1,645,798
Barber, beauty shops	....	11,359	....	3,103	....	5,167	945	....	....	....	722	....	8,285	29,581
Misc. mercantiles	669,246	1,102,898	193,583	563,352	427,710*b*	1,418,900	175,497	987,931	704,229*b*	101,843	115,155	66,153	642,281	7,168,778
Warehouses	60,526	426,199	11,990	97,832	62,671	385,535	69,869	527,123	1,289	....	....	217,700	155,335	2,016,069
IV. Manufacturing														
Metal workers	700	30,936	....	6,043	50	9,782	....	....	210,011	290	148	....	30,604	288,564
Woodworkers	....	300	....	466	....	39,764	....	....	....	2,550	217,687	350	1,390	262,507
Flour mills, elevators	....	257,664	50	91,625	65,045	....	44,816	....	9,374	53,827	2,525	....	47,374	572,300
Packing plants, stockyards	50	....	150	....	....	3,784	....	....	....	10,600	....	6,500	5,481	26,565
Bakeries	17,254	27,784	4,613	1,379	....	3,161	....	....	....	....	11,470	300	8,306	74,267
Laundries	6,715	17,782	10	1,834	15,634*c*	69,083	....	8,766	....	2,487	115	115	1,279	123,820
Cleaners, tailors	....	2,001	2,230	18,522	....	28,250	....	17,721	....	1,860	165	....	852	71,601
Misc. manufacturing	757,787	903,251	978,135	140,952	12,805	15,395,049	44,683	2,997,490	491,828	15,209	24,795	551,100	468,469	22,781,553
V. Miscellaneous														
Barns	216,155	703,110	33,063	311,747*d*	395,818	435,547	....	866,467	343,184*g*	86,491*g*	696,417*d*	....	847,621	4,931,000
Outbuildings	82,529	179,398	5,780	52,943	....	51,241	116,616	85,097	....	1,400	4,263	67,550	97,467	744,284
Lumber yards	....	76,705	40,080	1,300	6,027	59,206	59,999	285,476	313,205	91,340	....	350	4,998	938,686
Railroads, wharves	96,676	21,645	1,622	12,853	....	133,185	....	....	....	562	81	1,446	821	268,891
Bulk oil storage, refineries	16,056	413,515	....	449	34,756*e*	....	....	....	16,685	1,263	....	....	....	482,724
Garages, filling stations	171,167	450,968	157,182	86,272	24,257*f*	214,258	44,785	362,136	81,701	57,465	29,525	71,303	115,659	1,866,678
Power plants, pump houses	....	41,044	4,750	5,654	2,583	16,044	....	....	34,884	1,610	13,073	....	27,014	146,661
Creameries, dairies	....	....	500	2,177	1,761	....	....	....	....	558	....	....	8,720	13,716
Miscellaneous structures	8,450	221,989	10,827	107,455	23,576	100,806	145,068	934,567	....	....	....	100	67,784	1,620,622
Motor vehicles, inc. aircraft	56,404	142,523	16,773	41,764	20,089	101,312	36,346	173,281	58,675	13,479	....	32,377	130,386	823,409
Fires other than structures	18,587	40,061	4,036	6,589	....	2,906	....	4,952	....	7,789	337	1,225	127,110	213,592

*Insurance losses only.
†Fiscal year ending June 30, 1942.
‡Fiscal year ending June 30, 1941.
a. Does not include farm property.

b. Includes office buildings.
c. Includes cleaners.
d. Includes all farm property.
e. Includes filling stations.

f. Includes airplane hangars.
g. Includes outbuildings.
h. Includes restaurants.

Table III. Number of Fires by Causes in Thirteen States — 1941.

Causes	Connecticut	Illinois	Indiana‡	Iowa	Kansas	Massachusetts	Nebraska	Ohio	Oregon*	South Dakota†	Vermont	West Virginia	Wisconsin	Total
Chimneys, flues — defective, overheated	152	955	85	246	121	595	119	1,813	680	64	518	51	1,484	6,883
Sparks on roofs	50	1,496	259	792	175	190	100	3,310*c*	486	....	46	2	741	7,647
Defective or overheated heating equipment	105	1,210	10	220	265	228	....	2,145	711	34	185	....	426	5,550
Rubbish	63	1,831	13	....	26	....	....	330	60	32	20	4	163	2,542
Combustibles near heaters	10	....	7	37	....	180	....	....	....	....	....	18	163	415
Open lights, flames, sparks	101	466	....	184	53	483	61	584	135	56	48	2	621	2,794
Hot ashes, coals	21	239	48	36	102	100	22	520	456	16	65	1	218	1,844
Oil burners	212	....	....	30	....	132	....	....	....	13	....	....	224	611
Smoking	365	2,859	47	437	189*b*	1,730	106	5,551*b*	2,416*b*	59	415*b*	26	3,286	17,486
Children and matches	82	....	....	71	....	445	41	985	....	41	....	10	276	1,951
Matches	54	....	21	50	....	205	....	....	....	9	....	3	397	739
Electrical	171	2,162	79	353	247	769	131	2,748	644	103	114	10	1,457	8,988
Elect'al appliances, motors	82	160	23	108	8	52	11	574	293	16	37	....	673	2,037
Flammable liquids, home dry cleaning, starting fires	68	893	26	123	60	381	48	1,149	130	11	140	....	109	3,138
Torches, welding	50	....	9	37	....	72	....	166	....	14	....	....	60	408
Films	....	....	....	11	....	....	....	8	....	2	....	....	6	27
Lamps and stoves	58	....	101	229	....	237	220	....	....	89	....	....	585	1,518
Gas and appliances	8	124	....	1	5	9	8	184	....	....	4	1	23	367
Grease, tar, etc	49	238	....	33	48	139	17	264	437	....	38	....	384	1,647
Spontaneous ignition	54	593	21	138	67	342	69	833	102	37	20	2	283	2,561
Fireworks	....	41	....*a*	1*a*	2	90	....	26	12	1	14	....*a*	28	215
Lightning	25	314	9	114	67	74	37	364	113	33	213	12	4,316	5,691
Thawing pipes	....	....	4	6	....	30	....	....	....	....	....	....	17	57
Sparks from machinery, friction	22	32	3	13	21	18	....	....	57	1	14	....	37	218
Incendiary, suspicious	56	66	7	19	13	265	11	224	16	7	1	20	38	743
Miscellaneous	115	....	79	152	2	18	119	2,198	36	102	11	....	432	3,264
Unknown	259	1,955	118	437	491	250	313	1,816	1,114	86	423	315	900	8,477
Explosions	8	205	36	13	29	47	....	....	115	24	11	16	964	1,468
Exposure	18	843	10	184	57	218	59	861	288	26	134	19	267	2,984

*Number of insurance claims, not number of fires.
†Fiscal year ending June 30, 1942.
‡Fiscal year ending June 30, 1941.

a. Fireworks limited to supervised displays (1941).
b. Includes matches.
c. Includes sparks from stacks.

‡Fiscal year ending June 30, 1941.

b. Includes matches.
c. Includes sparks from stacks.

Table IV. Fire Loss by Causes in Thirteen States — 1941.

Causes	Connecticut	Illinois	Indiana‡	Iowa	Kansas	Massachusetts	Nebraska	Ohio	Oregon*	South Dakota†	Vermont	West Virginia	Wisconsin	Total
Chimneys, flues — defective, overheated	$91,711	$401,321	$57,404	$249,126	$52,584	$427,544	$49,490	$561,364	$150,530	$26,368	$116,519	$76,847	$379,237	$2,640,045
Sparks on roofs	67,222	508,161	64,265	361,378	44,907	154,377	23,056	596,184c	139,221	....	19,127	18,350	186,472	2,182,720
Defective or overheated heating equipment	173,496	386,972	10,706	145,991	104,052	200,957	....	868,038	225,928	68,995	80,163	....	289,099	2,449,406
Rubbish	70,051	44,252	2,605	....	9,039	....	....	105,178	9,887	2,651	6,370	10,925	24,043	285,001
Combustibles near heaters	24,965	....	635	21,281	....	125,355	....	....	....	....	....	27,545	20,353	220,134
Open lights, flames, sparks	46,235	254,245	....	93,290	24,402	2,001,008	12,038	101,673	11,823	12,536	10,533	1,325	121,114	2,695,222
Hot ashes, coals	23,659	81,046	91,312	8,449	8,863	62,255	7,199	150,005	23,388	1,715	26,679	150	31,172	515,892
Oil burners	400,828	....	....	13,161	....	129,362	....	....	....	1,348	....	....	92,663	637,362
Smoking	314,145	185,911	11,075	156,259b	29,321	1,908,659	21,407	648,788b	272,011b	13,866	35,178b	22,597	300,549	3,919,765
Children and matches	69,003	....	....	11,319	....	233,418	16,295	111,285	....	10,310	....	5,675	46,396	503,701
Matches	38,346	....	8,549	14,663	....	242,383	....	....	....	4,000	....	1,100	17,449	326,490
Electrical	615,000	843,102	74,611	194,581	141,979	1,262,443	70,961	948,633	377,223	144,573	138,405	9,070	655,514	5,476,095
Elect'al appliances, motors	77,574	7,658	5,475	75,999	1,307	88,751	1,266	57,833	37,302	2,777	3,261	....	148,936	508,039
Flammable liquids, home dry cleaning, starting fires	90,376	740,346	11,390	39,480	16,500	409,043	46,176	519,450	48,703	1,922	43,345	....	16,007	1,982,738
Torches, welding	112,798	....	157,530	13,690	....	144,322	....	131,912	....	5,131	....	....	17,948	583,331
Films	....	....	....	13,147	....	....	....	26,894	....	240	....	....	1,316	41,597
Lamps and stoves	85,717	....	105,000	68,115	....	137,395	148,036	....	....	44,149	....	....	182,463	770,875
Gas and appliances	55,870	22,367	....	6,000	179	53,473	4,732	84,932	....	....	88	5,500	2,192	235,333
Grease, tar, etc	679,816	20,389	....	8,145	10,758	197,360	9,463	58,071	23,075	....	1,829	....	21,755	1,030,651
Spontaneous ignition	52,055	209,091	19,492	240,579	63,675	747,494	57,502	1,850,292	95,634	26,935	18,589	1,180	412,193	3,794,711
Fireworks	....	4,952	....a	35a	190	23,864	....	9,543	2,887	50	372	....a	2,790	44,683
Lightning	28,150	813,505	117,525	203,256	104,383	145,182	34,275	250,618	206,896	19,451	63,999	16,560	459,294	2,503,094
Thawing pipes	....	....	224	793	....	16,189	....	....	....	....	....	....	14,667	31,873
Sparks from machinery, friction	93,886	9,025	1,100	2,351	25,275	49,121	....	....	143,948	25	26,426	....	5,594	356,751
Incendiary, suspicious	99,422	73,559	2,817	20,049	5,509	498,775	14,151	347,441	54,859	3,329	1,000	507,240	65,341	1,693,492
Miscellaneous	69,683	....	23,185	92,325	1,687	10,043	122,620	672,399	5,018	19,431	722	....	145,410	1,162,523
Unknown	1,172,812	4,081,817	936,230	1,104,621	780,471	15,924,126	585,822	3,040,524	1,209,745	247,178	872,697	874,275	1,121,484	31,951,802
Explosions	196,865	70,820	139,858	48,863	14,000	106,098	....	....	88,130	12,809	6,771	23,035	174,310	881,559
Exposure	34,625	565,265	9,810	243,097	107,146	517,874	39,628	238,616	182,957	25,469	75,983	42,350	139,095	2,221,955

*Insurance losses only.
†Fiscal year ending June 30, 1942.
‡Fiscal year ending June 30, 1941.

a. Fireworks limited to supervised displays (1941).
b. Includes matches.
c. Includes sparks from stacks.

Table VI shows the total estimated number of fires and fire losses distributed by occupancies and based on the data in the previous tables. Table VII shows similar figures by causes. These occupancy and cause classifications are not listed in any order of importance, but are grouped so that similar classes come together. Each class is broad in scope in order to reduce the number of classes to a minimum and permit the compilation of a sufficient amount of data on each to be of value. Several of the fire marshals' reports use much longer lists of occupancies and causes by subdividing the general classes shown in the accompanying tables. For example, some states divide the occupancy class, "Dwellings," into "City Dwellings" and "Farm Dwellings," and the cause class, "Lightning," into "Rodded" and "Unrodded."

To arrive at the estimates shown in Tables VI and VII the procedure outlined above was applied to the figures for each class in previous tables, except for those classes where data were lacking from several states. In such instances proportional increases in the total estimates were made. For example, some states did not give fires in "Barber, beauty shops," and the estimate of the total number of barber and beauty shops was therefore adjusted in accordance with the number of states reporting. A corresponding reduction was then made in other classes. In this particular example the "Miscellaneous" and "Mercantile" classes were reduced, as it is likely that the states not reporting barber and beauty shops used these classes for recording such fires.

Table V. Fires per 1000 Population and Fire Loss per Person for Thirteen States, 1941, as Reported by Fire Marshals.

State	Population 1940 Census	Number Fires	Fires per 1000 Population	Fire Loss	Fire Loss Per Person
Connecticut	1,709,242	2,258	1.29	$4,784,310	$2.81
Illinois	4,500,433(a)	16,682	3.69	9,323,804	2.07
Indiana	3,427,796	1,015	2.96	1,850,808	.54
Iowa	2,538,268	4,085	1.60	3,455,043	1.36
Kansas	1,801,028	2,049	1.14	1,546,277	.86
Massachusetts	3,545,905(b)	7,081	1.99	25,380,535	7.15
Nebraska	1,315,834	1,492	1.14	1,264,117	.97
Ohio	6,907,612	26,653	3.87	11,379,673	1.65
Oregon	1,089,684	8,301	7.61	3,309,165	3.04
South Dakota	642,961	876	1.36	695,258	1.18
Vermont	359,231	2,471	7.00	1,548,056	4.31
West Virginia	1,901,974	512	2.69	1,674,764	.88
Wisconsin	3,137,587	18,578	5.94	5,124,856	1.63
Total	32,877,555	92,053	2.79	$71,336,666	2.17
Estimated U. S. Total.	131,669,275	736,000	5.58	$325,000,000*	2.47

(a) Excluding Chicago.
(b) Excluding Boston.
* In estimating total U. S. loss the $11,000,000 Fall River rubber loss was included only at its initial value.

Table VI. Estimated Distribution of U. S. Fire Losses by Occupancies, 1941.

These estimated figures are intended to show the relative order of magnitude of fire losses by occupancies, and while they are reasonable approximations based on the experience in typical states they should not be taken as exact records for each class.

Occupancy	No. of Fires	Loss
I. PUBLIC BUILDINGS		
Government buildings	900	$250,000
Hospitals, institutions	1,000	1,500,000
Schools	2,700	8,000,000
Churches	2,600	6,000,000
Theatres	1,300	1,500,000
Amusements, halls	3,100	3,500,000
II. DWELLING OCCUPANCIES		
Hotels, boarding houses	9,500	3,000,000
Apartments, rooming houses	40,500	5,500,000
Dwellings	345,000	86,000,000
III. MERCANTILES		
Office buildings	5,100	8,000,000
Restaurants, taverns	10,500	8,000,000
Barber, beauty shops	1,200	250,000
Miscellaneous mercantiles	42,500	35,000,000
Warehouses	6,800	12,500,000
IV. MANUFACTURING		
Metal workers	1,800	2,000,000
Woodworkers	2,000	4,750,000
Flour mills, elevators	2,000	4,000,000
Packing plants	200	2,800,000
Bakeries	900	600,000
Laundries	1,500	750,000
Cleaners, tailors	1,400	600,000
Miscellaneous manufacturing	21,000	58,000,000
V. MISCELLANEOUS		
Barns	32,000	24,500,000
Outbuildings	25,000	3,250,000
Lumber yards	1,400	5,500,000
Railroad, wharf property	1,000	6,500,000
Bulk oil storage, refineries	1,900	3,250,000
Garages, filling stations	32,500	9,000,000
Power plants, pump houses	1,200	1,000,000
Creameries and dairies	500	200,000
Miscellaneous structures	25,000	13,500,000
Motor vehicles, including aircraft	90,000	4,000,000
Fires other than structures	22,000	1,800,000
Totals	736,000	$325,000,000

NOTE: As explained in the text, 100 per cent has been added in estimating the number of fires, and 30 per cent has been added to the losses to cover unreported losses.

Taking another example, six states did not report the number of fires or amount of fire loss due to the cause, "Matches." Accordingly, the estimated totals reported by the other states were increased and corresponding reductions were apportioned among the class, "Smoking," under which it is assumed that the six states probably recorded fires caused by matches.

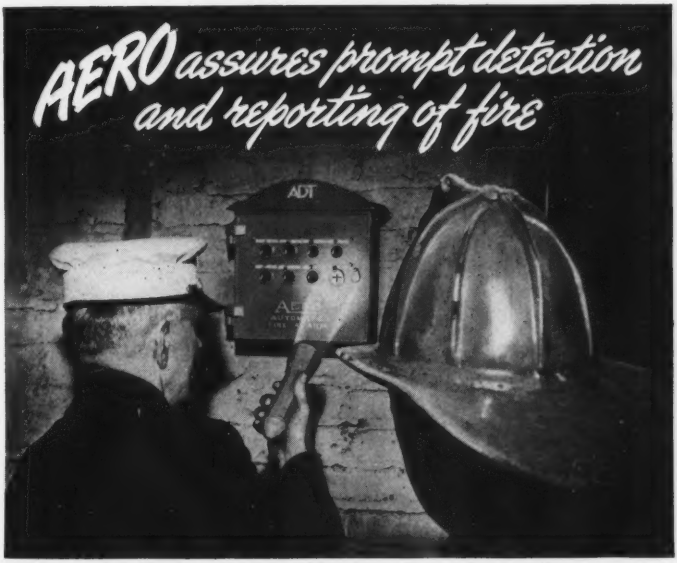
As previously emphasized, these fire experiences are approximate estimates, but give a fair indication of the distribution of losses by occupation and cause classifications.

Table VII. Estimated Distribution of U. S. Fire Losses by Causes — 1941.

These estimated figures are intended to show the relative order of magnitude of fire losses by causes, and while they are reasonable approximations based on the experience in typical states they should not be taken as exact records for each class.

Cause	No. of Fires	Loss
Chimneys, flues—defective or overheated	50,000	$11,400,000
Sparks on roofs	60,000	9,500,000
Defective or overheated heating equipment	46,000	14,250,000
Rubbish	23,000	1,600,000
Combustibles near heaters	9,000	2,100,000
Open lights, flames, sparks	22,000	11,500,000
Hot ashes, coals	15,000	2,250,000
Oil burners	12,000	5,000,000
Smoking	125,000	16,750,000
Children and matches	22,000	3,500,000
Matches	10,000	2,500,000
Electrical	62,000	23,300,000
Electrical appliances, motors	15,000	2,300,000
Flammable liquids, misc., including home dry cleaning and starting fire	24,000	9,100,000
Torches, welding	6,000	4,500,000
Films	1,000	250,000
Lamps and stoves	20,000	6,000,000
Gas and appliances	3,500	1,250,000
Grease, tar, etc.	15,000	5,700,000
Spontaneous ignition	18,500	16,000,000
Fireworks	2,000	300,000
Lightning	40,000	9,500,000
Thawing pipes	1,500	450,000
Sparks from machinery, friction	2,000	2,000,000
Incendiary, suspicious	5,500	7,250,000
Miscellaneous	28,000	6,750,000
Unknown	62,000	136,000,000
Explosions	14,000	4,500,000
Exposure	22,000	9,500,000
Totals	736,000	$325,000,000

NOTE: As explained in the text, 100 per cent has been added in estimating the number of fires, and 30 per cent has been added to the losses to cover unreported losses.



Thousands of concerns find A.D.T. Automatic Protection Systems a wartime necessity

No matter how complete your present fire protection may *seem*, your fire defenses are but half-way measures unless they include means for *detecting and reporting fire automatically*. For only by automatic means can you have the assurance that fire will be discovered and the alarm transmitted in those vital first few minutes that may mean the difference between an incident and a disaster.

The A.D.T. Aero Automatic Fire Alarm effectively and economically eliminates the hazards of belated discovery and delayed alarms. No matter where on the premises a fire may start ...no matter what the hour of day or night...Aero automatically dectects the outbreak *when it starts*, and automatically summons the fire department direct to the premises.

For sprinklered properties, A.D.T. provides Sprinkler Supervisory and Waterflow Alarm Service, which automatically summons the fire department the instant a sprinkler head opens. This service also automatically detects and reports trouble conditions (whether caused by accident or sabotage) that might impair the sprinkler's effectiveness.

Write for free descriptive booklets.

A.D.T. AUTOMATIC FIRE DETECTING AND REPORTING SYSTEMS

Controlled Companies of **AMERICAN DISTRICT TELEGRAPH CO.** *155 Sixth Ave., New York*

CENTRAL STATION OFFICES IN ALL PRINCIPAL CITIES OF THE U.S.

A·D·T

Electric Protection Services

AGAINST FIRE · BURGLARY · HOLDUP

A NATION-WIDE ORGANIZATION

FREE!

—THIS FIRE-FIGHTING POSTER

Do your new employees know how to use your fire-fighting equipment? If not, here's the answer.

Walter Kidde & Company have prepared a graphic poster that quickly teaches correct operation of most widely used types of portable fire extinguishers. It covers Carbon Dioxide, Foam, Water, and Vaporizing Liquid. It tells for what kind of fire each is used . . . *and how it is used.* Simple in design, it can be understood at a glance, even after a fire is under way.

Display one of these posters beside every one of your extinguishers. Just write Walter Kidde & Company for the number you need.

Walter Kidde & Company
Incorporated
1037 WEST STREET, BLOOMFIELD, N. J.

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Make floors SAFE in hazardous finishing areas! Use FACT-O-CRETE floors in

Powder Rooms, Loading Lines, Spray Booths, Paint Rooms, Camouflage Buildings and other hazardous finishing areas.

FACT-O-CRETE floor in the Paint Room of a Western Aircraft Plant. Floor is turned up at walls and columns to prevent water seepage to areas underneath. Four other Paint Rooms and the Camouflage Building in this plant are also Fact-O-Crete protected. Total area installed was 181,000 square feet.

- FIREPROOF, SPARKPROOF
- OIL AND PAINT PROOF
- DUSTLESS, WATERTIGHT
- LIGHTWEIGHT, SEAMLESS
- ECONOMICAL

FACT-O-CRETE was developed in 1925 at the suggestion of Underwriters, who desired a lightweight flooring for application over wood or concrete sub-flooring in old or new construction. Today it is being used in all parts of the country; in airplane plants, furniture factories, machine shops and similar places. It is easily and rapidly installed either by local help or by our skilled installation crews, who are available anywhere. Areas installed one day are ready for use the following morning. Fact-O-Crete is fully guaranteed. Estimates on cost of installations given upon receipt of job conditions and approximate size of areas contemplated.

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FREE Sample: A full size sample of Fact-O-Crete showing its application to a wood subfloor will be sent on request — with specifications for your files. Write for it.

- Our Warehouses are in Wichita, Kansas, New York City, but address all correspondence to

E. H. O'NEILL FLOORS COMPANY
706 North Wells Street, Chicago, Illinois

Flaming Canvas Target for Torpedo

FLAMING SHIP IS EASY PREY FOR U-BOAT

Torpedo Comes Quickly As Stack Fire Spreads To Tarpaulins

Baltimore Captain And Crew Of 34 Escape Before Shelling

[By the Associated Press]

Portland, Maine, April 26—Thirty-five shells and a single torpedo fired by a German submarine blasted a medium-sized American freighter to the bottom of the North Atlantic the night of April 20, the navy disclosed today after the vessel's entire crew of thirty-five arrived here uninjured. All but four were Americans.

Crew members revealed that a fire in the freighter's smokestack, which spread to tarpaulins, five minutes before the attack, made the ship an easy target for the submarine

The hazards of war are great enough without adding the peril of flammable canvas.

For a few cents more per yard the tarpaulins on this ship could have been made of FIRE CHIEF treated duck — the permanent fire-resisting finish that won't wash out — and a vital ship might have been saved.

Wherever flammable canvas presents a hazard, indoors or out, from sabotage or carelessness, FIRE CHIEF treated canvas assures safety

Approved by both the Underwriters Laboratories and the Associated Factory Mutual Fire Insurance Companies. Meets all Government requirements.

WM. E. HOOPER & SONS CO.
New York PHILADELPHIA Chicago
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FIRE CHIEF *The Finish That WON'T WASH OUT*

TRADE C-O-TWO MARK

PROTECTS GRAND COULEE

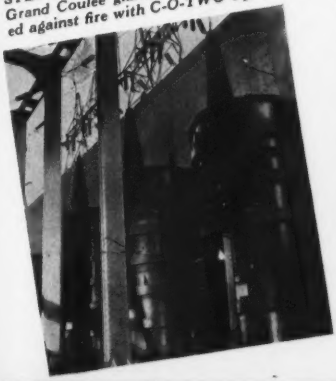
Man's greatest structure—Grand Coulee alone it will generate more hydro-[illegible] than the 241 power plants in the states New York, Massachusetts and Pennsylvania. Here at Grand Coulee, as at Boulder Dam, Bonneville Dam, and other mighty power plants, gargantuan turbines, transformers and oil storage vaults are protected against fire at all times by C-O-TWO automatic and manually operated fire extinguishing systems and C-O-TWO portables.

IT'S SAFER because IT'S FASTER

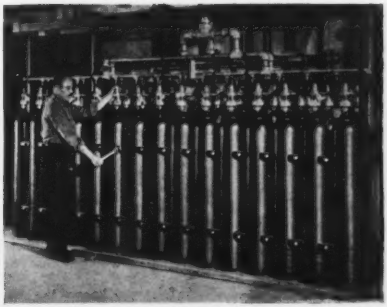
All C-O-TWO equipment employs carbon dioxide, the fastest non-damaging fire extinguishing agent. C-O-TWO is recommended and approved for protecting oil, grease, paint, lacquer, alcohol, butane and other highly flammable chemicals against fires. C-O-TWO stops fire in split seconds without damage to machinery or materials.

THE FIRING LINE
Two of the 108,000 kilowatt generators, only one-ninth of the Grand Coulee ultimate installation, C-O-TWO protected.

STEPPING UP FIGHTING POWER
Grand Coulee giant transformers protected against fire with C-O-TWO equipment.



C-O-TWO is a registered trademark. To be safe, specify C-O-TWO and this company's name when ordering.



BOMBS OF PROTECTION
Bank of 60 C-O-TWO cylinders to protect Grand Coulee oil storage rooms.

C-O-TWO FIRE EQUIPMENT COMPANY
NEWARK, NEW JERSEY

Your copy of this bulletin will be sent on request.

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Supervisory Equipment for Industrial Sprinkler Systems

VIKING supervisory equipment guards against sprinkler system failure. Don't take the chance of having the water supply shut off from YOUR sprinkler system. VIKING can supply you with the necessary supervisory devices to give an electric alarm or signal whenever any essential valve on your sprinkler system is disturbed from its normal wide-open position, or if the pressure gets too low.

THE VIKING CORPORATION

HASTINGS, MICHIGAN

WARNING TO GESTAPO AGENTS! Do not try to force your way into a DETEX-protected plant, because you will receive a welcome that you will never forget. DETEX is doing an all-out job of safeguarding American War production.

In civilian enterprises, too, DETEX Watchclocks are hanging up a glorious record of service, all the more remarkable since replacements are available only on orders carrying Priority Ratings.

To make sure your DETEX will continue to serve you for the duration, send in your watchclock now for its periodic cleaning and oiling. Your local distributor will furnish you with free loan equipment while repairs are being made with genuine DETEX parts. Play safe — entrust your DETEX equipment only to the manufacturer.

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84 Varick Street, New York
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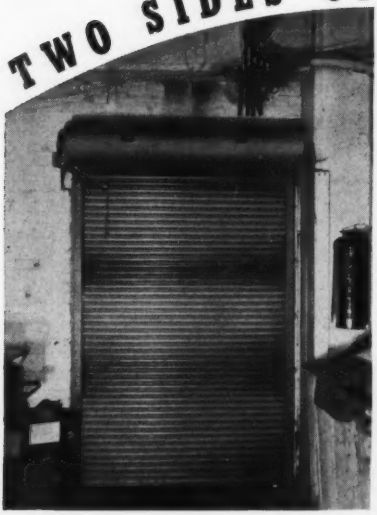
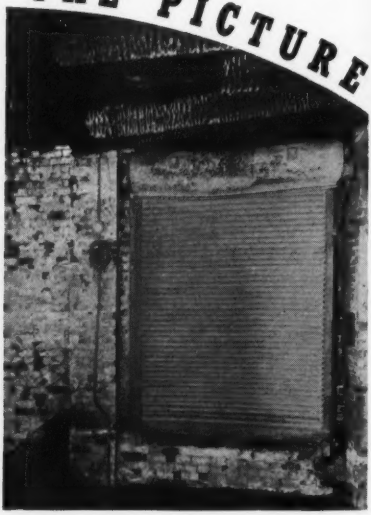
DETEX WATCHMENS CLOCKS

NEWMAN • ECO • ALERT • PATROL

TWO SIDES OF THE PICTURE





. . . KINNEAR ROLLING DOORS *Made the Difference*

Here's graphic demonstration of automatic Kinnear Fire Door performance. The picture at the right shows clearly some disastrous results of a major building fire. In the above picture is seen the opposite side of the wall in the picture at right . . . the same wall, but with a notable difference! Two Kinnear Fire Doors in a single firewall opening stopped the passage of flames, drafts and smoke and absolutely prevented damage in this room adjacent to the conflagration.

Check These Kinnear Automatic Fire Door Features Against Your Needs!

- Positive, spring-driven closure.
- Automatic stoppage at floor level.
- Safe, controlled downward travel.
- Can be raised after closure and closes again automatically.
- Quick and easy resetting.
- Often lowers insurance rates, enough to offset door costs.

KINNEAR FIRE DOORS ARE APPROVED AND LABELED BY UNDERWRITERS' LABORATORIES INC.

WRITE FOR COMPLETE INFORMATION TODAY

THE KINNEAR MFG. CO., 2250-70 Fields Ave., Columbus, Ohio

SAVING WAYS IN DOORWAYS

KINNEAR ROLLING DOORS

WARTIME • PEACETIME • ALL THE TIME
HOFFMAN 140-F IS THE

The Hoffman 140-F Drycleaning Unit is approved by the National Board of Fire Underwriters as a Class II Unit—for use in conjunction with listed petroleum solvents having a flash point of 138.2°F. or over. The war shortage of chlorine has had no effect upon the legitimate operations of drycleaners using this equipment and solvent. Hoffman 140-F still provides approved, safe drycleaning operations.

U. S. HOFFMAN MACHINERY CORPORATION
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EQUIPMENT FOR EVERY DEPARTMENT OF THE DRY CLEANING PLANT

WHEN STORM CLOUDS GATHER!
There is always a period of calm before the storm which cautious men use to set their houses in order. If the storm breaks, every one is glad he took the indicated precautions. If it blows over, the precautions were a cheap form of insurance.
Today it's judicious to have all petroleum supplies — stored or rolling — properly protected. • We are specialists in safeguarding both storage and truck tanks, and will gladly give you the benefit of our experience.
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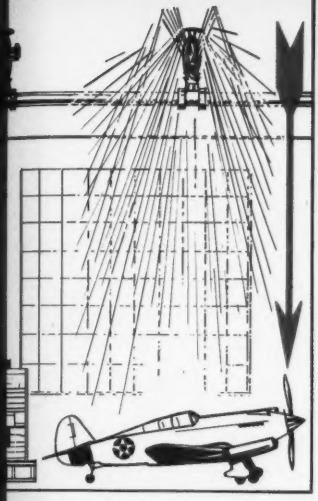


Fighting Fire VERTICALLY with a SPRINKLER SYSTEM

1. Sprinkler System already in place — ready for action, *automatically*, when and where the fire starts.

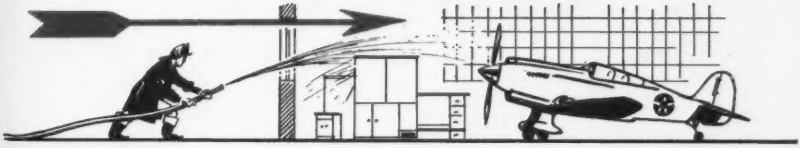
2. Sprinkler System puts water right on the fire while it is a little fire . . . automatically, immediately, unerringly. No delay and no guesswork about where to put the water and how much—for, the answers to these questions were built into the Sprinkler System.

3. The sprinklers are already at the ceiling, *right over the fire*. The proper amount of water falls VERTICALLY on the fire. In a warehouse or factory housing ordinary materials, the sprinklers pop off one or two at a time — just fast enough to control and extinguish the fire. In an airplane hangar or explosives plant, the water is discharged from a number of open sprinklers simultaneously — to be always *ahead* of the progress of the fast spreading fire.

4. Since all the thinking has been done for the Sprinkler System in designing and installing, it has only to discharge water on the fire. No confusion. No fear of smoke or fire.

• • •

Fighting Fire HORIZONTALLY with HOSE STREAMS



1. Hose streams must be *brought* to the fire by *men* . . . who cannot act until *somebody* gives the alarm.

•

2. *Men* must decide how to fight the fire with hose streams. During the time consumed in arriving or if the alarm comes late, the fire may become so great it must be fought from outside . . . through windows and doors.

•

3. Whether men are fighting from outside or inside the building — since they are fighting fire HORIZONTALLY with hose streams — *everything* is in their way . . . walls, partitions, stacked goods, airplanes, machinery, shelving. Countless obstacles tend to prevent hose streams from reaching the seat of the fire . . . wasting time and water. Moreover, powerful hose streams cause breakage of materials.

•

4. Hose lines must be lifted, guided . . . water shut off while extra lengths of hose are added. Men may become confused, exhausted or suffocated by smoke, which also obscures the objective. And the fire may be so intense that it prevents men from approaching closely enough to work efficiently.

SUPROTEX SYSTEMS OF AUTOMATIC SPRINKLERS — FOR WAREHOUSES AND FACTORIES • SUPROTEX-DELUGE SYSTEMS OF OPEN SPRINKLERS — FOR AIRPLANE HANGARS AND EXPLOSIVE WORKS

"AUTOMATIC" SPRINKLER CORP. OF AMERICA

YOUNGSTOWN, OHIO • OFFICES IN PRINCIPAL CITIES

INDUSTRY ANSWERS THE CALL!

32,145 FIRMS WITH MORE THAN 17,700,000 EMPLOYEES HAVE INSTALLED THE PAY-ROLL SAVINGS PLAN

Have YOU Started the Pay-Roll Savings Plan in YOUR Company?

Like a strong, healthy wind, the Pay-Roll Savings Plan is sweeping America! Already more than 32,145 firms, large and small, have adopted the Plan, with a total of over seventeen million employees—and the number is swelling hourly.

But time is short! The best and quickest way to raise urgently needed billions of dollars is by giving *every* American wage earner a chance to participate in the regular, systematic purchase of Defense Bonds.

Do *your* part by installing the Pay-Roll Savings Plan now.

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MAKE EVERY PAY DAY . . . BOND DAY

U. S. Defense BONDS ★ STAMPS

Fire-Fighters Appreciate

VALVES
HYDRANTS

AND PIPE LINE ACCESSORIES

M & H products are well known for high quality material and expert workmanship. They have been widely used throughout the country for many years. They include several types of Gate Valves, Check Valves, Flap Valves, Valve Boxes, B & S Fittings, Flanged Fittings, Fire Hydrants and many other cast iron pipe line accessories.

AWWA & UNDERWRITERS APPROVED FIRE HYDRANTS

M & H Fire Hydrants are dry top and revolving head. They are easy to lubricate. Maintenance costs are low due to simplicity of design and rugged construction. They have low friction loss and great efficiency because barrel diameter is not reduced and there are no working parts or obstruction in waterway. Special Traffic model is designed to yield at the ground line under impact. Repair is simple and easy by renewing breakable bolts and breakable coupling on stem.

M&H VALVE
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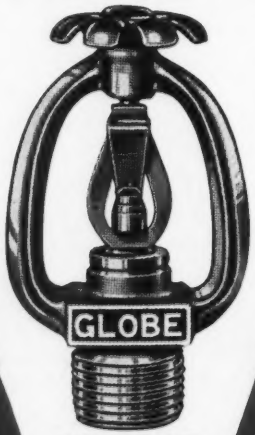
ANNISTON, ALABAMA

READY FOR AFFORDING

GLOBE SAVEALL SPRINKLER

TROUBLE PROTECTION

THAT MAY BE NEEDED AT ANY MOMENT



ON THE ALERT

GLOBE DEVICES—SERVE AND CONSERVE MAXIMUM OF ENGINEERING INGENUITY WITH A MINIMUM USE OF CRITICAL METALS

APPROVED BY ALL GOVERNMENT AND INSURANCE AUTHORITIES

GLOBE SYSTEMS THOROUGHLY DEFEND GOVERNMENT AIRCRAFT PLANTS, HANGARS, SHOPS, HOSPITALS AND DEFENSE PLANTS ASSURING THAT FIRE INTERRUPTION TO SCHEDULES WILL NOT OCCUR

THE "ALL CLEAR" OF FIRE PROTECTION

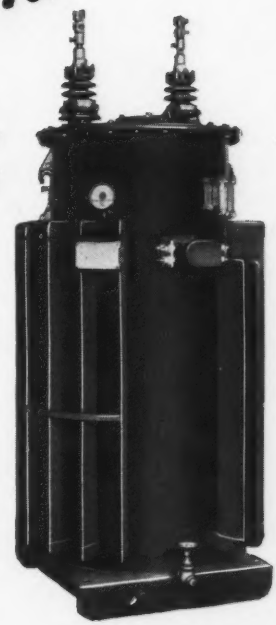
GLOBE AUTOMATIC SPRINKLER COMPANY

Sales and Engineering Offices in Principal Cities

To Decrease Fire Hazard in Wartime Plants

To Save Critical Materials, Time, Money

Recommend PYRANOL TRANSFORMERS



PYRANOL is General Electric's noninflammable, synthetic cooling liquid for electric equipment. Transformers cooled with this liquid can't add fire hazard—even if heat from surrounding blazes ruptures the tank—because *Pyranol can't burn.* Fire fighters appreciate this safety feature. Not one Pyranol transformer in 10 years of operating experience has burned or contributed to a fire.

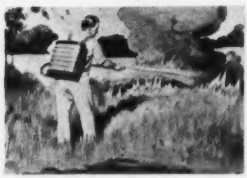
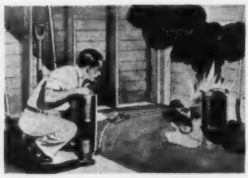
Because Pyranol is noninflammable, the National Electrical Code permits Pyranol transformers to be installed without fireproof enclosures, either indoors or outdoors. This saves critical construction materials, floor space, and installation time, and keeps runs of secondary copper short. Pyranol transformers can be installed in the basement, on a beam, or in any unused area near the load center.

For complete information ask for Bulletin GEA-2637. *General Electric, Schenectady, N. Y.*

You can't burn PYRANOL

GENERAL ELECTRIC

402-57-5100

OF INTEREST TO EVERY HOME OWNER

IN WAR-TIME, the fire-fighting facilities of a community may be overtaxed if a series of fires should occur, or the enemy should stage an air raid. It is desirable that families should be prepared to do what they can to save their own homes in case of fire.

With the object of providing information which may be helpful to home owners and aid in preventing war-time fire losses, a new folder, "Fire Defense for Your Home in War-Time," has been issued.

The new folder, which is being distributed through our local representatives, briefly and clearly describes the more commonly known types of fire extinguishers and their uses. By means of illustrations and descriptions, the folder explains what types of equipment are or are not suited for fighting grass, wood, flammable liquid, grease and electrical fires. A special section is devoted to incendiary bomb fires, giving the latest approved methods of combating such fires.

A copy of "Fire Defense for Your Home in War-Time" will be sent upon request.

THE AUTOMOBILE INSURANCE COMPANY
THE STANDARD FIRE INSURANCE COMPANY
of Hartford, Connecticut
AFFILIATED WITH THE ÆTNA LIFE INSURANCE COMPANY

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ANY

HUGE FIRE LOSSES IMPEDE WAR EFFORT

To call the Fire Department when fire occurs is elementary, yet the record shows that Delayed Alarms are contributing largely to the appalling destruction of national resources. Witness the following few of many instances:

S.S. "NORMANDIE." " . . . a delay of 10 to 15 minutes between the start of the fire and the first alarm received by the fire department. The fire apparatus arrived in 90 seconds after the alarm was given. The S.S. *Normandie* is reported to have cost $53,000,000.00."

JERSEY CITY WATERFRONT CONFLAGRATION. Loss: $5,000,000.00. "There appears to have been some delay in sounding the alarm, estimated by city authorities at 20 minutes."

WAREHOUSES. Loss: $1,000,000.00. "When the fire was discovered by the watchman the flames had already burned the telephone wires and he had to go a quarter of a mile to a railroad roundhouse to telephone the alarm."

BRONZE AND ALUMINUM FOUNDRY. Loss: $1,000,000.00. "Employees were apparently unable to locate fire alarm boxes with which the plant was equipped and an alarm was telephoned to the fire department."

FALL RIVER RUBBER FIRE. Loss: $11,000,000.00. "The foreman's attempts to extinguish the fire with an extinguisher were futile. A delay of six minutes or more appears to have occurred."

Fire alarm boxes, adequately distributed, provide the most dependable means for calling the Fire Department. Deficiencies in Signaling Systems cannot be eliminated now, materials are not available, but greater safety may be achieved by the intelligent use of existing facilities.

When Fire Occurs — Use the Box Immediately

• • •

THE GAMEWELL COMPANY

NEWTON UPPER FALLS
MASSACHUSETTS

England's Report

on Sprinkler Fire Protection!

Here is an amazing report from the scene of history's worst fire perils. It is an authentic record of the performance of automatic sprinkler fire protection in actual air raids. And it shows that no premises fully protected by automatic sprinklers with a dependable water supply have been destroyed by incendiary bomb fires in England!

Reprinted for the first time in this country, this Bulletin throws new light on protective measures against impending incendiary bombings on our own continent . . . 250 incendiary bombing incidents in sprinkler equipped buildings throughout industrial Britain form the basis of this Report.

Complimentary copies are available for the asking.

Grinnell Company, Inc., Executive Offices, Providence, R. I.

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AUTOMATIC SPRINKLER FIRE PROTECTION